

# **Syllabus of the Engineering in Analytical Chemistry and Instrumentation Curriculum**

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| Module                             | GM1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Energetic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Reminders of Thermodynamics,<br><b>Chapter II:</b> Energy balances,<br><b>Chapter III:</b> Real gases<br><b>Chapter IV:</b> Fluid flow processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide a solid understanding of classical thermodynamics and its applications to physical and chemical processes.</li><li>• Focus on energy transformations, real gas behavior, and fluid flow in engineering systems.</li><li>• Equip students with theoretical and practical tools for analyzing energy balances and thermodynamic functions.</li><li>• Apply thermodynamic concepts to industrial systems such as chemical reactors and thermal machines.</li><li>• Explain fundamental thermodynamic concepts and laws.</li><li>• Perform energy and thermal balance calculations.</li><li>• Apply the Van der Waals equation and corresponding states theory to real gases.</li><li>• Interpret compressibility charts and Pitzer correlations.</li><li>• Analyze and optimize fluid flow systems.</li><li>• Use thermodynamic tools for process design and performance evaluation in chemical engineering.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     | X                         |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | General Physics (mechanics, heat, and basic electricity), General Chemistry (including physical chemistry concepts such as chemical reactions, enthalpy, entropy, Mathematics (differential and integral calculus, basic differential equations), Introduction to Thermodynamics (basic notions at the undergraduate level)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Fundamentals of Engineering Thermodynamics</b> – Michael J. Moran, Howard N. Shapiro.<br><b>Introduction to Chemical Engineering Thermodynamics</b> – J.M. Smith, Hendrick Van Ness, and Michael M. Abbott<br><b>Chemical Engineering Thermodynamics</b> – Y.V.C. Rao<br><b>Thermodynamics: An Engineering Approach</b> – Yunus A. Çengel, Michael A. Boles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

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| Module                             | GM1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Module coordinator                 | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course name                        | Thermodynamics of Solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course teacher                     | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                           | ECTS          |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Nb of hours |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Lecture     | Seminar | Practical Course/Lab work | Personal work |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 21          | 14      |                           | 7             |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Reminders on functions with several variables: Homogeneous functions.<br><b>Chapter II:</b> What is a solution?<br><b>Chapter III:</b> Equilibria between phases in ideal solutions and very dilute solutions General expressions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide a thorough understanding of thermodynamics of mixtures and solutions.</li><li>• Focus on chemical potential, phase equilibria, and behavior of ideal and real solutions.</li><li>• Equip students with tools to analyze multicomponent systems and quantify mixing and partial molar properties.</li><li>• Predict solution behavior under various conditions.</li><li>• Define and calculate thermodynamic quantities in mixtures.</li><li>• Apply Raoult’s and Henry’s laws to dilute solutions.</li><li>• Interpret and use phase diagrams effectively.</li><li>• Evaluate colligative properties such as freezing point depression and boiling point elevation.</li><li>• Understand solubility of gases and solids in different media.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |                           |               | CS1 | CS2 | CS3 | CS4  | CS5  | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X | X |  |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CS3         | CS4     | CS5                       | CS6           | CS7 | CS8 | CS9 | CS10 | CS11 |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| X                                  | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Prerequisite                       | <b>General Chemistry</b> (especially physical chemistry concepts)<br><b>Thermodynamics</b> (introductory level)<br><b>Mathematics</b> (multivariable calculus, partial derivatives)<br>Familiarity with phase changes and solution behavior                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Introduction to Chemical Engineering Thermodynamics</b> – J.M. Smith, H.C. Van Ness & M.M. Abbott<br><b>Physical Chemistry</b> – P. Atkins & J. de Paula<br><b>Chemical Thermodynamics for Process Simulation</b> – Jürgen Gmehling, Bärbel Kolbe<br><b>Thermodynamics of Solutions</b> – Jacob W. Prigogine (for deeper theoretical background)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |                           |               |     |     |     |      |      |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |

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| Module                             | GM1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Module coordinator                 | Mohamed Kadri Younes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course name                        | Chemical kinetics and catalysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course teacher                     | Mohamed Kadri Younes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Description                 | Chapter I: Chemical reaction rate<br>Chapter II: Speed equation – Concept of order<br>Chapter III. Influence of temperature on reaction rate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide a thorough understanding of the thermodynamics of mixtures and solutions.</li><li>• Focus on chemical potential, phase equilibria, and behavior of ideal and real solutions.</li><li>• Equip students with theoretical tools to analyze multicomponent systems.</li><li>• Quantify mixing and partial molar properties.</li><li>• Predict solution behavior under various conditions.</li><li>• Define and calculate thermodynamic quantities in mixtures.</li><li>• Apply Raoult’s and Henry’s laws to dilute solutions.</li><li>• Interpret and utilize phase diagrams effectively.</li><li>• Evaluate colligative properties such as freezing point depression and boiling point elevation.</li><li>• Understand the solubility of gases and solids in different media.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (especially physical chemistry concepts), Thermodynamics (introductory level),Mathematics (multivariable calculus, partial derivatives)<br>Familiarity with phase changes and solution behavior                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | Introduction to Chemical Engineering Thermodynamics – J.M. Smith, H.C. Van Ness & M.M. Abbott<br>Physical Chemistry – P. Atkins & J. de Paula<br>Chemical Thermodynamics for Process Simulation – Jürgen Gmehling, Bärbel Kolbe<br>Thermodynamics of Solutions – Jacob W. Prigogine (for deeper theoretical background)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
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| Module                             | GM1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Module coordinator                 | Rafâa Besbes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course name                        | Organic chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course teacher                     | Rafâa Besbes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               | ECTS |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Nb of hours |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 21          | 14      |     |                           |     |     | 7             |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Specific writing and Nomenclature<br><b>Chapter II:</b> Stereochemistry<br><b>Chapter III:</b> Electronic Effects<br><b>Chapter IV:</b> Reminder of reaction mechanisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide a solid foundation in organic chemistry, focusing on structure, stereochemistry, electronic effects, and reaction mechanisms.</li><li>• Teach classification and IUPAC nomenclature of organic and heterocyclic compounds for standardized communication.</li><li>• Cover stereochemistry, including molecular conformations, chiral centers, stereoisomers, and prochirality.</li><li>• Explain electronic effects such as inductive, mesomeric, and aromaticity for predicting reactivity and stability.</li><li>• Review key reaction mechanisms: nucleophilic and electrophilic substitutions, additions, eliminations, oxidation, and reduction.</li><li>• Enable students to apply IUPAC nomenclature correctly.</li><li>• Analyze molecular stereochemistry and three-dimensional behavior of organic molecules.</li><li>• Understand and interpret the influence of electronic effects on reactivity.</li><li>• Propose reaction pathways for essential organic transformations.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X | X |  |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| X                                  | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Prerequisite                       | <b>General Chemistry</b> (structure of atoms and molecules, periodic table, chemical bonding)<br><b>Basics of Organic Chemistry</b> (functional groups, types of organic reactions)<br>Introductory knowledge of reaction mechanisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Organic Chemistry</b> – Paula Yurkanis Bruice<br><b>Introduction à la chimie organique</b> – John McMurry (French edition available)<br><b>Stereochemistry of Organic Compounds</b> – Ernest L. Eliel & Samuel H. Wilen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |   |  |  |  |  |  |  |  |  |  |

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| Module                             | GM1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Module coordinator                 | Monia Hichri / Mohamed Kadri Younes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Course name                        | Practical work in thermodynamics and kinetics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Course teacher                     | Saoussen Wacharine / Kaïs Antar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     | 14                        |     |     | 14            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Course Description                 | <b>Handling No. I:</b> Second order reaction, conductivity meter<br><b>Handling No. II:</b> Kinetics of acetone iodination by spectrometry<br><b>Handling No. III:</b> Determination of the activity energy of the reaction hydrolysis acid, ethyl acetate<br><b>Handling No. IV:</b> Determination of partial molar value<br><b>Handling No. V:</b> Cryoscopic study of a dilute solution of a hydrocarbon in solution in cyclohexane<br><b>Handling No. VI:</b> Calorimetric study of a water-glucose mixture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Reinforce and apply theoretical knowledge of chemical kinetics and solution thermodynamics through experiments.</li><li>• Measure reaction rates and determine activation energy.</li><li>• Investigate kinetics of second-order reactions using conductivity measurements.</li><li>• Follow the iodination of acetone via spectrophotometry.</li><li>• Determine activation energy of acid-catalyzed hydrolysis.</li><li>• Calculate partial molar quantities to characterize solution behavior.</li><li>• Perform cryoscopic studies to evaluate molar mass and interactions in dilute hydrocarbon solutions.</li><li>• Conduct calorimetric analysis to measure enthalpic changes in water-glucose mixtures.</li><li>• Develop skills in experimental design, data analysis, and interpretation of physicochemical phenomena related to kinetics and thermodynamics.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  |  |  |  |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      | X    |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Prerequisite                       | Chemical kinetics (rate laws, reaction orders, Arrhenius equation); Thermodynamics (enthalpy, entropy, partial molar properties); Physical chemistry lab techniques (conductometry, spectrophotometry, calorimetry); Basic lab safety and data analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |
| Recommended Texts & Other Readings | <b>Experimental Physical Chemistry</b> – Arthur W. Adamson<br><b>Physical Chemistry Laboratory Manual</b> – David P. Shoemaker et al.; <b>Chimie Physique Expérimentale</b> – J.-P. Eyméoud & M. S. Lemaire (for French version)<br><b>Physical Chemistry</b> – Peter Atkins & Julio de Paula (chapters on kinetics and thermodynamics)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |   |

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| Module                             | GM1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Module coordinator                 | Abdessatar Cherni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Course name                        | Titrimetry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Course teacher                     | Abdessatar Cherni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Oxidation-reduction assays<br><b>Chapter II:</b> Complexometric dosages<br><b>Chapter III:</b> Acid-base dosages<br><b>Chapter IV:</b> Dosages by precipitation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Understand fundamental principles and practical techniques of quantitative chemical analysis by titration.</li><li>• Master oxidation-reduction titrations, including electrode potentials, pH effects, and titration curve interpretation.</li><li>• Apply redox titration methods such as iodometry, bromometry, chromimetry, and periodimetry.</li><li>• Learn complexometric titrations focusing on metal-ligand complex formation and selective titration in mixtures.</li><li>• Study acid-base titrations in aqueous and non-aqueous media, including advanced methods like Kjeldahl.</li><li>• Explore precipitation titrations, applying solubility product concepts and indicator behaviors through classical methods (Mohr, Volhard, Charpentier, Fajans).</li><li>• Prepare and calibrate titration solutions accurately.</li><li>• Interpret titration curves and select suitable indicators.</li><li>• Quantify a wide variety of chemical species across different media and reaction types.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  | X | X | X |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | X           | X       | X   |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (oxidation-reduction, solubility, acid-base theory)<br>Analytical Chemistry (concentration units, solution preparation)<br>Physical Chemistry (equilibrium, electrochemistry, complex formation)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Quantitative Chemical Analysis</b> – Daniel C. Harris; <b>Vogel's Textbook of Quantitative Chemical Analysis</b> – J. Mendham et al.; <b>Chimie Analytique</b> – Christian Trémillon (for French-speaking students); <b>Analytical Chemistry</b> – Gary D. Christian                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |   |  |  |  |  |  |  |

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| Module                             | GM1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Module coordinator                 | Noureddine Raouafi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Course name                        | Applied Electrochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Course teacher                     | Noureddine Raouafi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Course Description                 | <b>Chapter I:</b> Electrolytes<br><b>Chapter II:</b> General information on electrode processes<br><b>Chapter III:</b> Intensity-potential curves<br><b>Chapter IV:</b> Equation of the $I=f(E)$ curves of some fast systems<br><b>Chapter V:</b> Classic polarography<br><b>Chapter VI:</b> Impulse polarographic methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>Understand the properties and behavior of electrolytes and ionic interactions based on Debye-Hückel theory.</li><li>Explore electrical conductivity and equivalent conductivity in ionic solutions.</li><li>Learn methods for determining individual ionic contributions.</li><li>Study electrode processes, electrochemical cells, redox reactions, and mass transfer in solutions.</li><li>Analyze current-potential (<math>i = f(E)</math>) curves to characterize electrochemical behavior.</li><li>Understand principles and instrumentation of classical and pulsed polarography.</li><li>Learn about electrodes and electroactivity domains in polarographic techniques.</li><li>Apply polarographic methods to detect and quantify electroactive species.</li><li>Interpret electrochemical data and construct <math>i = f(E)</math> curves.</li><li>Use classical and advanced polarographic techniques in quantitative analysis.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X | X | X |  |  |  | X | X |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| X                                  | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X           |         |     |                           | X   | X   |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Prerequisite                       | General Chemistry (oxidation-reduction, ionic compounds, solution chemistry); Physical Chemistry (thermodynamics, kinetics, equilibrium); Basic Electrochemistry (electrode potentials, redox couples); Introductory Analytical Chemistry (instrumentation and measurement techniques)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |
| Recommended Texts & Other Readings | <b>Electrochemical Methods: Fundamentals and Applications</b> – Allen J. Bard & Larry R. Faulkner<br><b>Electrochemistry</b> – Carl H. Hamann, Andrew Hamnett, Wolf Vielstich<br><b>Introduction to Electrochemistry</b> – S. Glasstone<br><b>Techniques in Electroanalytical Chemistry</b> – Kissinger & Heineman;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |   |   |  |  |  |   |   |  |  |  |

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| Module                             | GM1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Module coordinator                 | Amine Mnif                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Course name                        | Chemistry of Aqueous Solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Course teacher                     | Amine Mnif                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Course Description                 | <p><b>Chapter I:</b> Aqueous solutions</p> <p><b>Chapter II:</b> Acid-base balances</p> <p><b>Chapter III:</b> Solubility and precipitation-solubilization reactions</p> <p><b>Chapter IV:</b> Complexation reactions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide a comprehensive understanding of aqueous chemical equilibria, including electrolytes, acid-base reactions, solubility, and complexation.</li><li>• Introduce thermodynamic and structural analysis of aqueous solutions, including Ostwald's dilution law and activity coefficients.</li><li>• Develop skills in acid-base equilibria calculation using Brønsted's theory and classical or reaction-dominant methods.</li><li>• Explain buffer solution preparation and behavior under dilution or acid/base addition.</li><li>• Detail solubility and precipitation equilibria and influencing factors such as temperature, pH, common ion effect, and complexation.</li><li>• Explore complexation reactions, focusing on formation, stability, and predominance of complexes.</li><li>• Enable students to model and calculate equilibrium conditions in aqueous systems.</li><li>• Predict precipitation or solubility outcomes accurately.</li><li>• Understand the role of complex formation in aqueous environments.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  | X |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | X           |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (chemical reactions, equilibrium, acid-base concepts); Basic Thermodynamics (Gibbs free energy, equilibrium constants); Introductory Analytical Chemistry (solution preparation, concentration units)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <p><b>General Chemistry: Principles and Modern Applications</b> – Petrucci, Herring, Madura; <b>Physical Chemistry for the Life Sciences</b> – Peter Atkins &amp; Julio de Paula; <b>Chimie en solution – Équilibres chimiques</b> – Jean-Louis Burgot (for French-speaking students)</p> <p><b>Chemical Equilibria in Analytical Chemistry</b> – Fritz &amp; Schenk</p> <p><b>Principles of Modern Chemistry</b> – Oxtoby, Gillis, Campion</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |  |  |  |  |  |  |  |

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| Module                             | GM1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Module coordinator                 | Abdessatar Cherni / Nouredine Raouafi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Course name                        | Practical work in titrimetry and electrochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Course teacher                     | Abdessatar Cherni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     | 21                        |     |     | 21            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Course Description                 | <b>Handling No. I:</b> Dosage of EDTA<br><b>Handling No. II:</b> Conductivity<br><b>Handling No. III:</b> Fluoride dosage<br><b>Handling No. IV:</b> Chromimetric dosage<br><b>Handling No. V:</b> The complexes<br><b>Handling No. VI:</b> Potentiometric dosage of Nikel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Apply key analytical chemistry concepts through practical experiments in titrimetry, electrochemistry, and complexometric analysis.</li><li>• Reinforce theoretical knowledge via hands-on chemical quantification processes.</li><li>• Master preparation and standardization of solutions.</li><li>• Handle laboratory equipment and select appropriate analytical methods based on chemical species and matrix.</li><li>• Perform complexometric titrations such as EDTA titrations.</li><li>• Measure solution conductivity and carry out redox titrations including chromimetry.</li><li>• Determine fluoride content and analyze coordination complexes.</li><li>• Conduct potentiometric titrations with precision.</li><li>• Interpret experimental results critically and construct calibration curves when needed.</li><li>• Apply safety and quality control practices in analytical laboratories.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X | X |  |  |  | X | X |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | X           |         |     |                           | X   | X   |               |      | X    |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Prerequisite                       | General Chemistry (redox reactions, coordination compounds); Fundamentals of Analytical Chemistry (titration theory, concentration units); Electrochemistry basics (electrodes, potential, ion-selective measurements); Laboratory safety and handling of reagents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |
| Recommended Texts & Other Readings | <b>Quantitative Chemical Analysis</b> – Daniel C. Harris; <b>Vogel’s Textbook of Quantitative Chemical Analysis</b> – J. Mendham et al.; <b>Analytical Chemistry: A Modern Approach to Analytical Science</b> – Robert Kellner et al.<br><br><b>Institutional lab manuals or handbooks specific to the experimental protocols</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |  |  |   |   |  |  |   |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Module coordinator                 | Mohamed Lotfi Efrif                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Course name                        | Functional Analysis in Organic Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Course teacher                     | Mohamed Lotfi Efrif                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14          | 5       |     |                           |     |     | 2             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Course Description                 | Chapter I: Structure of organic molecules<br>Chapter II: Chemical tests                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>Identify and classify organic molecules through structural analysis and specific chemical tests.</li><li>Study organic compound composition, empirical and structural formulas, centesimal analysis, and unsaturation calculations.</li><li>Learn qualitative reactions to detect functional groups such as halogens, alkenes, alcohols, phenols, aromatic compounds, carbonyls, amines, and amino acids.</li><li>Observe color changes, precipitate formation, and other indicators for molecular identification.</li><li>Bridge theoretical organic chemistry with practical analytical methods for compound classification and structure elucidation.</li><li>Analyze elemental composition and determine degrees of unsaturation.</li><li>Perform classical qualitative tests to detect specific functional groups.</li><li>Interpret experimental results to differentiate compound families (e.g., alcohols vs. phenols, aldehydes vs. ketones).</li><li>Propose structural hypotheses based on test outcomes.</li><li>Use diagnostic reagents such as DNPH, Jones reagent, Tollen’s test, and ninhydrin.</li><li>Follow standardized laboratory protocols.</li><li>Apply logical reasoning to confirm or eliminate potential functional groups in unknown samples.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  | X | X | X |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X           | X       | X   |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (structure of atoms and molecules, periodic table, chemical bonding); Basics of Organic Chemistry (functional groups, structure, isomerism)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |
| Recommended Texts & Other Readings | Introduction to Organic Laboratory Techniques – Pavia, Lampman, Kriz & Engel<br>Organic Qualitative Analysis – Shriner, Hermann, Morrill, Curtin & Fuson                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |   |   |  |  |  |  |  |  |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Module coordinator                 | Noureddine Amdouni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Course name                        | Qualitative Analysis Inorganic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Course teacher                     | Noureddine Amdouni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Reminder<br><b>Chapter II:</b> General evolution of atomic properties<br><b>Chapter III:</b> The salts<br><b>Chapter IV:</b> Oxides and hydroxides<br><b>Chapter V:</b> Inorganic quantitative analysis<br><b>Chapter VI:</b> Quantitative analysis of cations metallic<br><b>Chapter VII:</b> Qualitative analysis of anions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Understand the periodic table structure and how periodic classification reflects chemical behavior.</li><li>• Analyze the evolution of atomic and chemical properties such as ionization energy, electron affinity, and electronegativity.</li><li>• Study periodic variations in redox and valence behavior.</li><li>• Classify and predict reactions of inorganic compound families: salts, oxides, and hydroxides.</li><li>• Explore dissolution techniques, acid properties, and sample preparation methods for analysis.</li><li>• Conduct systematic qualitative and quantitative analyses of cations and anions.</li><li>• Identify ions through precipitation, complexation, and confirmatory reactions.</li><li>• Interpret periodic trends and their influence on chemical reactivity.</li><li>• Apply logical approaches to identify unknown inorganic compounds using group-based methods.</li><li>• Develop theoretical and practical foundations in inorganic reactivity and analysis.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  | X |  | X |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | X           |         | X   |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (chemical bonding, periodic table, acid-base theory); Inorganic Chemistry fundamentals (oxidation states, compound types)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Descriptive Inorganic Chemistry</b> – Geoff Rayner-Canham & Tina Overton; <b>Inorganic Chemistry</b> – Gary L. Miessler, Paul J. Fischer, Donald A. Tarr; <b>Quantitative Chemical Analysis</b> – Daniel C. Harris (for analytical aspects); <b>Vogel’s Qualitative Inorganic Analysis</b> – G. Svehla                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |   |  |   |  |  |  |  |  |  |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Module coordinator                 | Mohamed Faouzi Zid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course name                        | Solid State and Metallurgy<br>Part I: Solid state                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course teacher                     | Mohamed Faouzi Zid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                           |               | ECTS |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Nb of hours |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Lecture     | Seminar | Practical Course/Lab work | Personal work |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14          | 5       |                           | 2             |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Description                 | <b>Chapter I:</b> Symmetry<br><b>Chapter II:</b> Crystallized solids: from the ionic model to the compound iono-covalent<br><b>Chapter III :</b> Non-stoichiometric solids<br><b>Chapter IV:</b> The Oxides                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Understand principles of crystal symmetry and symmetry operations in solids.</li><li>• Describe and classify 2D and 3D crystal systems.</li><li>• Identify structural types of ionic and ionic-covalent solids, including classic models (NaCl, ZnS) and complex compounds (perovskites, spinels).</li><li>• Apply Pauling's rules to predict and analyze crystal structures.</li><li>• Analyze non-stoichiometric solids, including defects and solid solutions.</li><li>• Classify oxides by structure and acid-base behavior in aqueous solutions.</li><li>• Link microscopic structural features to macroscopic chemical properties, stability, and reactivity.</li><li>• Interpret crystallographic data and understand energetic implications of structural variations.</li><li>• Develop foundational skills in solid-state chemistry relevant to material formation and behavior.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |                           |               |      | CS1 | CS2 | CS3  | CS4  | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  | X |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CS3         | CS4     | CS5                       | CS6           | CS7  | CS8 | CS9 | CS10 | CS11 |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             | X       |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (bonding, periodic table, lattice structures); Basic Crystallography (unit cell, packing types); Introductory Inorganic Chemistry (ionic/covalent character, oxidation states)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Solid State Chemistry: An Introduction</b> – Lesley E. Smart & Elaine A. Moore; <b>Introduction to Solid State Chemistry</b> – Nivaldo J. Tro or MIT OpenCourseWare (OCW) version by Donald Sadoway; <b>Inorganic Chemistry</b> – Gary L. Miessler, Paul J. Fischer; <b>Crystal Structure Determination</b> – Werner Massa (for symmetry and crystallography concepts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |                           |               |      |     |     |      |      |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Module coordinator                 | Chiraz Abdemalek                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course name                        | Solid State and Metallurgy<br>Part II: Metallurgy – Physico-chemistry of development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course teacher                     | Chiraz Abdemalek                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |     |                           |     |     |               | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Nb of hours |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Lecture     | Seminar |     |     | Practical Course/Lab work |     |     | Personal work |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 14          | 5       |     |     |                           |     |     | 2             |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Description                 | Chapter I: Study of ore<br>Chapter II: Physical treatments of ores<br>Chapter III: Chemical treatment of ores<br>Chapter IV: Elaboration of metal<br>Chapter V: Refining<br>Chapter VI: Refining-super refining-High purity metals<br>Chapter VII: Shaping of metals and alloys                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>Identify and classify different types of ores using analytical methods.</li><li>Understand and apply physical treatment methods such as crushing, flotation, magnetic and electrostatic separation.</li><li>Explore chemical treatment processes including acid, alkaline, and halogen attacks.</li><li>Analyze thermal metallurgy techniques, including reduction reactions using Ellingham diagrams and various reducing agents.</li><li>Learn electrochemical metallurgy in aqueous and molten phases.</li><li>Describe refining and purification methods like oxidation, distillation, sublimation, and zone melting.</li><li>Understand metal forming techniques such as forging, rolling, welding, and sintering.</li><li>Link theoretical principles to industrial applications in metallurgy and materials engineering.</li><li>Evaluate and select reduction processes based on thermodynamic criteria.</li><li>Analyze alloy behavior and welded materials in metal forming.</li><li>Assess strategies for producing high-purity metals.</li><li>Prepare for practical roles in mining, metallurgy, and materials science industries..</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |     |                           |     |     |               |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  | X |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CS3         | CS4     | CS5 | CS6 | CS7                       | CS8 | CS9 | CS10          | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | X       |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Prerequisite                       | General Chemistry (oxidation-reduction, acids/bases, thermochemistry); Inorganic Chemistry (oxides, salts, coordination compounds); Thermodynamics and Phase Diagrams; Basic Materials Science or Solid-State Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | Extractive Metallurgy: Principles and Applications – Fathi Habashi; Introduction to the Thermodynamics of Materials – David R. Gaskell; Metallurgical Thermochemistry – Carl Wagner<br>Physical Metallurgy Principles – Reed-Hill & Abbaschian                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |   |  |  |  |  |  |  |  |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Module coordinator                 | Mohamed Lotfi Efrit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Course name                        | Practical Organic Functional Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Course teacher                     | Abderrahmen Abdelli                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     | 14                        |     |     | 14            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Course Description                 | <b>Handling No. I:</b> Laboratory Safety<br><b>Handling No. II:</b> Purification of cyclohexanone<br><b>Handling No. III:</b> Functional group tests<br><b>Handling No. IV:</b> Esterification reaction<br><b>Handling No. V:</b> Preparation of acetanilide<br><b>Handling No. VI:</b> Preparation of parabromoacetanilide                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Emphasize laboratory safety practices for handling reagents, equipment, and waste.</li><li>• Develop technical skills in purification methods, including distillation of cyclohexanone.</li><li>• Perform functional group identification tests for alcohols, carbonyls, amines, and others.</li><li>• Conduct organic synthesis reactions such as esterification, acylation of aniline to acetanilide, and electrophilic aromatic substitution to produce parabromoacetanilide.</li><li>• Reinforce understanding of organic reactivity, purification, and structure–property relationships.</li><li>• Follow and implement organic synthesis protocols accurately.</li><li>• Purify and identify compounds based on physical and chemical properties.</li><li>• Apply classical qualitative methods for functional group analysis.</li><li>• Demonstrate proficiency with common lab equipment (distillation, reflux, filtration).</li><li>• Write clear and accurate laboratory reports including data interpretation and reaction mechanism analysis.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  | X |  | X | X |  |  |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | X           |         | X   | X                         |     |     |               |      | X    |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Prerequisite                       | Fundamentals of Organic Chemistry (functional groups, reaction types); General Chemistry Lab Skills (measuring, heating, filtration); Knowledge of basic reaction mechanisms (nucleophilic substitution, electrophilic addition/substitution); Laboratory safety and waste management protocols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |
| Recommended Texts & Other Readings | <b>Introduction to Organic Laboratory Techniques</b> – Pavia, Lampman, Kriz & Engel; <b>Organic Chemistry</b> – David R. Klein<br><b>Laboratory Techniques in Organic Chemistry</b> – Jerry R. Mohrig et al.<br>Institutional or department-specific lab manuals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |   |  |   |   |  |  |  |  |   |

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| Module                             | GM1.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Module coordinator                 | Noureddine Amdouni                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Course name                        | Practical Inorganic Qualitative Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Course teacher                     | Ramzi Hammami / Hend Najjar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               | ECTS |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nb of hours |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     | 21                        |     |     | 21            |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Course Description                 | <b>Handling No. I:</b> Analysis methods (I):<br><b>Handling No. II:</b> Methods of analysis (II):<br><b>Handling No. III:</b> Poorly soluble salts<br><b>Handling No. IV:</b> Hydroxides<br><b>Handling No. V:</b> Sulfides<br><b>Handling No. VI:</b> Analytical reactions<br><b>Handling No. VII:</b> Cation analysis (I)<br><b>Handling No. VIII:</b> Cation analysis (II)<br><b>Handling No. IX:</b> Anion analysis<br><b>Handling No. X:</b> Qualitative and quantitative analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Perform gravimetric and volumetric analyses of inorganic substances.</li><li>• Use ion exchange resins for selective separation or purification processes.</li><li>• Identify precipitation reactions involving poorly soluble salts, hydroxides, and sulfides.</li><li>• Interpret data from thermal analysis techniques (e.g., TGA, DTA).</li><li>• Analyze water samples to determine calcium, magnesium, and chloride content.</li><li>• Differentiate between major and trace ions in complex mixtures through systematic analysis.</li><li>• Design logical flowcharts for the systematic detection of cations and anions.</li><li>• Develop chemical reasoning related to reaction selectivity and analytical strategy.</li><li>• Master essential laboratory techniques such as accurate weighing, solution preparation, titration, and scientific report writing.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  | X | X |  |  |  |  |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | X           | X       |     |                           |     |     |               |      | X    |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Prerequisite                       | General Chemistry (ionic equilibria, precipitation, redox), Inorganic Chemistry (solubility, complexation, periodic properties); Basic Analytical Chemistry (titrimetry, gravimetry, acid-base equilibria); Laboratory technique fundamentals (filtration, weighing, solution prep)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |
| Recommended Texts & Other Readings | <b>Quantitative Chemical Analysis</b> – Daniel C. Harris; <b>Vogel’s Textbook of Quantitative Inorganic Analysis</b> – G.H. Jeffery et al.; <b>Inorganic Chemistry</b> – Miessler, Fischer & Tarr; <b>Laboratory manuals provided by the department or faculty</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |  |  |   |   |  |  |  |  |  |  |   |

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| Module                             | GM1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Module coordinator                 | Fethi Ouelseti                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course name                        | Spectroscopic Methods Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course teacher                     | Fethi Ouelseti                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
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| Course Description                 | <b>Chapter I:</b> General principles<br><b>Chapter II:</b> Infra-red absorption spectroscopy<br><b>Chapter III:</b> UV-visible Absorption Spectroscopy<br><b>Chapter IV:</b> Phototelectronic Hototelectronic Spectroscopy ESCA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Aims and Outcomes                  | <p>By the end of this course, students will be able to :</p> <ul style="list-style-type: none"><li>• Understand the fundamental principles of spectroscopy, including energy transitions, selection rules, and the electromagnetic spectrum.</li><li>• Apply Beer-Lambert and absorption laws in quantitative spectroscopic analysis.</li><li>• Interpret IR spectra by analyzing molecular vibrations (harmonic and anharmonic), group frequencies, and functional group signatures.</li><li>• Describe and evaluate IR instrumentation, including Fourier Transform Infrared (FTIR) systems.</li><li>• Recognize and compare complementary techniques, such as Raman spectroscopy and IR-derived spectral analysis.</li><li>• Analyze UV-Visible spectra, focusing on electronic transitions, chromophores, and the influence of molecular structure on absorption features.</li><li>• Use spectroscopic data for qualitative and quantitative analysis, including structural identification.</li></ul> <p>Understand and explain the principles of photoelectron spectroscopy (ESCA/XPS) and its use in surface and materials characterization.</p> <ul style="list-style-type: none"><li>• Integrate theoretical knowledge with practical data interpretation in solving spectroscopic problems.</li><li>• Assess instrumentation parameters and sample preparation methods relevant to different spectroscopic techniques.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X | X |  | X |  | X | X |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | X           |         | X   |                           | X   | X   |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Prerequisite                       | General and Physical Chemistry (molecular orbitals, bonding, energy levels); Quantum Chemistry (basics of transitions and selection rules); Introductory Analytical Chemistry (Beer-Lambert law, concentration measurement); Basic knowledge of instrumentation (optics, detectors, sample handling)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Recommended Texts & Other Readings | <b>Principles of Instrumental Analysis</b> – Skoog, Holler & Crouch; <b>Molecular Spectroscopy</b> – Jeanne L. McHale; <b>Introduction to Spectroscopy</b> – Pavia, Lampman, Kriz & Vyvyan; <b>Department-provided spectroscopy lab manuals or spectra libraries</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |

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| Module                             | GM1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Module coordinator                 | Sahar Raissi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course name                        | Analysis by atomic absorption and emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course teacher                     | Sahar Raissi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course Description                 | <b>General Introduction.</b><br><b>Part I: Atomic absorption spectrometry:</b><br><b>Chapter I:</b> Atomic absorption spectrometry with flame.<br><b>Chapter II:</b> Disturbances of absorption spectrometry atomic.<br><b>Chapter III:</b> Electrothermal atomic absorption spectrometry.<br><b>Chapter IV:</b> Analysis of the elements and mercury<br><b>Part II: Atomic Emission Spectrometry:</b><br><b>Chapter I :</b> Introduction: The different sources of excitation<br><b>Chapter IV:</b> Flame atomic emission spectrometry.<br><b>Chapter V:</b> Atomic emission plasma spectrometry (AES-ICP).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Explain the working principles of atomic absorption spectrometry (AAS) and atomic emission spectrometry (AES).</li><li>• Identify different types of interferences in atomic spectrometry and know how to minimize or correct them.</li><li>• Select appropriate excitation sources (flame, electrothermal, plasma, arc, spark) depending on the sample and analysis objectives.</li><li>• Perform elemental analysis on complex matrices, including trace metals and volatile elements.</li><li>• Interpret spectrometric data in line with ISO standards and analytical best practices.</li><li>• Apply cold vapor AAS and hydride generation techniques for the determination of mercury and hydride-forming elements.</li><li>• Use ICP-AES for qualitative and quantitative analysis of solid and liquid samples in environmental and industrial contexts.</li><li>• Develop the ability to choose and justify the most appropriate atomic spectrometric technique based on analytical requirements.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X | X |  | X |  | X | X |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | X           |         | X   |                           | X   | X   |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Prerequisite                       | General and Analytical Chemistry (stoichiometry, concentration, titration); Instrumental Methods of Analysis (light-matter interaction, calibration); Physical Chemistry (energy levels, plasma physics basics); Basic Spectroscopy (emission/absorption principles)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |
| Recommended Texts & Other Readings | <b>Principles of Instrumental Analysis</b> – Skoog, Holler & Crouch; <b>Atomic Absorption Spectrometry</b> – B. Welz and M. Sperling; <b>Introduction to Atomic Spectroscopy</b> – C.N.R. Rao; <b>Analytical Atomic Spectrometry</b> – D. A. Skoog; <b>ISO standards and laboratory handbooks related to AAS and ICP techniques</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|--|---|---|--|---|--|---|---|--|--|---|
| Module                             | GM1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Module coordinator                 | Fethi Ouelseti                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course name                        | Practical work in molecular spectroscopy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course teacher                     | Ramzi Hammami                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     | 14                        |     |     | 14            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Description                 | <p><b>Handling No. I:</b> Atomic spectroscopy<br/>Helium emission spectrum</p> <p><b>Handling No. II:</b> Electron spectroscopy<br/>Ultraviolet<br/>Visible-spectrometric assay</p> <p><b>Handling No. III:</b> Infra-red spectroscopy<br/>Diatomic Molecule<br/>Introduction - quantitative analysis<br/>Application of infrared</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Operate basic spectroscopic instruments (atomic, UV-Vis, IR).</li><li>• Observe and analyze helium emission and UV-visible absorption spectra.</li><li>• Conduct IR spectroscopy on diatomic molecules and interpret vibrational data.</li><li>• Understand the principles of instrumentation and correct sample handling.</li><li>• Interpret spectral data for both qualitative identification and quantitative determination.</li><li>• Apply spectroscopic methods to deduce molecular structure and calculate concentrations.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X | X |  | X |  | X | X |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | X           |         | X   |                           | X   | X   |               |      | X    |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Prerequisite                       | Fundamentals of Spectroscopy (IR, UV-Vis, emission spectra); General and Physical Chemistry (electronic structure, molecular vibrations); Basic Instrumentation (light sources, detectors, calibration); Familiarity with Beer-Lambert Law and absorption/emission concepts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Recommended Texts & Other Readings | <p><b>Introduction to Spectroscopy</b> – Pavia, Lampman, Kriz &amp; Vyvyan</p> <p><b>Principles of Instrumental Analysis</b> – Skoog, Holler &amp; Crouch</p> <p><b>Molecular Spectroscopy</b> – Jeanne L. McHale</p> <p><b>Laboratory manuals on IR, UV-Vis, and atomic emission techniques provided by the institution</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |

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| Module                             | GM1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Module coordinator                 | Sahar Raissi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course name                        | Practical work in Emission Spectrometry and Atomic Absorption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course teacher                     | Sahar Raissi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     | 14                        |     |     | 14            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Description                 | <p><b>Handling No. I:</b> Determination of copper by absorption spectrometry atomic with flame.</p> <p><b>Handling No. II:</b> Calcium dosage by absorption spectrometry atomic flame: Study of the interaction between the element to be measured (Calcium) and the element disturbing (Aluminum) in different environments (HNO<sub>3</sub>; HCl).</p> <p><b>Handling No. III:</b> Dosage of sodium by absorption spectrometry and atomic emission with flame.</p> <p><b>Handling No. IV:</b> Dosage of zinc by absorption spectrometry atomic with flame in a complex matrix: application of the metered addition method.</p> <p><b>Handling No. V:</b> Determination of mercury by absorption spectrometry atomic in cold vapor</p> <p><b>Handling No. VI:</b> Dosage of some elements in drinking water by atomic emission spectrometry with plasma torque by induction (<i>According to the international standard ISO 11885</i>)</p> <p>This manipulation is carried out at the National Institute of Research and Physico-chemical Analysis in Sidi Thabet as part of a study visit</p> |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Perform elemental quantification using flame AAS, cold vapor AAS, and ICP-AES.</li><li>• Determine elements such as copper, calcium, sodium, zinc, and mercury in various sample matrices.</li><li>• Manage matrix effects and spectrometric interferences in complex samples.</li><li>• Apply appropriate calibration methods and quality control procedures.</li><li>• Interpret analytical data according to international standards, including ISO 11885.</li><li>• Gain exposure to professional atomic spectrometry practices through a study visit to INRAP.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td>X</td></tr></table>                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X | X |  | X |  | X | X |  |  | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | X           |         | X   |                           | X   | X   |               |      | X    |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Prerequisite                       | General Chemistry; Basic Instrumental Analysis; Fundamentals of Atomic Absorption and Emission Spectroscopy; Knowledge of calibration and dilution methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |
| Recommended Texts & Other Readings | <p><b>Principles of Instrumental Analysis</b> – Skoog, Holler &amp; Crouch</p> <p><b>Atomic Absorption Spectrometry</b> – B. Welz &amp; M. Sperling</p> <p><b>ISO 11885 standard (for ICP-AES in water analysis)</b></p> <p><b>Institutional lab manuals for AAS and ICP</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |   |  |   |  |   |   |  |  |   |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|--|--|--|--|--|--|
| Module                             | GM1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Module coordinator                 | Zeineb Ghardallou                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course name                        | Probability and Statistics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course teacher                     | Zeineb Ghardallou                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Description                 | <p><b>Part 1: Probabilities</b><br/><b>Chapter I:</b> Probability space<br/><b>Chapter II:</b> Discrete random variables<br/><b>Chapter III:</b> Real random variables<br/><b>Chapter IV:</b> Limit theorems and approximations<br/><b>Part 2: Statistics</b><br/><b>Chapter I:</b> Descriptive statistics for a single variable<br/><br/><b>Chapter II:</b> Descriptive statistics for two variables<br/><b>Chapter III:</b> Estimate</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Define probability spaces and compute probabilities for a variety of events.</li><li>• Understand and apply conditional probability and the concept of independence.</li><li>• Describe discrete and continuous random variables using appropriate probability distributions.</li><li>• Apply key distributions such as the normal, binomial, and Poisson distributions.</li><li>• Understand and interpret the law of large numbers and the central limit theorem.</li><li>• Summarize data using graphical and numerical methods for one or two variables.</li><li>• Perform point estimation and construct confidence intervals.</li><li>• Apply estimation techniques such as the method of moments and maximum likelihood estimation.</li><li>• Analyze and interpret real data sets using statistical tools.</li><li>• Use statistical reasoning to draw valid inferences about populations from samples.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Prerequisite                       | Calculus basics (differentiation, integration); Algebra and functions; Basic set theory and logical reasoning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | <p><b>A First Course in Probability</b> – Sheldon Ross</p> <p><b>Introduction to the Theory of Statistics</b> – Mood, Graybill &amp; Boes</p> <p><b>Statistical Inference</b> – Casella &amp; Berger</p> <p><b>Mathematical Statistics with Applications</b> – Wackerly, Mendenhall &amp; Scheaffer</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |  |  |  |  |  |  |



|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|--|---|--|--|--|--|--|--|--|---|---|
| Module                             | GM1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Module coordinator                 | Mounir Ayachi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Course name                        | Practical work in Computer Science                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Course teacher                     | Mounir Ayachi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     | 21                        |     |     | 21            |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Course Description                 | Exercises to perform on the computer among the TD series                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Aims and Outcomes                  | <div><ul style="list-style-type: none"><li>• Provide a practical introduction to programming in C through hands-on computer sessions.</li><li>• Teach writing, compiling, and debugging of C code.</li><li>• Cover essential language elements such as program structure, input/output functions, control flow statements, and syntax rules.</li><li>• Explain fundamental data types, operators, expressions, and control instructions.</li><li>• Emphasize application of concepts by developing and testing programs.</li><li>• Introduce arrays and data management techniques.</li><li>• Enable students to confidently create and troubleshoot C programs.</li><li>• Teach implementation of decision-making and loops.</li><li>• Build a solid foundation for more advanced programming projects.</li></ul></div> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td>X</td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  | X |  |  |  |  |  |  |  | X | X |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
|                                    | X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               | X    | X    |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Prerequisite                       | <b>Basic computer literacy</b><br>Understanding fundamental programming concepts (variables, logic) is helpful but not mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |
| Recommended Texts & Other Readings | <b>Programming in C Language with Corrected Exercises</b> – Claude Delannoy<br><b>Programming in C Language</b> – J.M. Rigaud & A. Sayah<br><b>The C Programming Language</b> – Brian W. Kernighan & Dennis M. Ritchie (classic reference)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |   |  |  |  |  |  |  |  |   |   |

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| Module                             | GM1.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Module coordinator                 | Maha Saighi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course name                        | French (expression technique)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course teacher                     | Maha Saighi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 14          | 5       |     |                           |     |     | 2             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Description                 | <b>Chapter I:</b> Recruitment file<br><b>Chapter II:</b> Research presentation file (PFE, memory report, etc.)<br><b>Chapter III:</b> Practical language file                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Provide essential tools for professional communication and academic writing through hands-on practice.</li><li>• Teach preparation of recruitment documents: cover letters, CVs, job interviews, and internship reports.</li><li>• Instruct on document structuring and common mistake avoidance.</li><li>• Facilitate interview simulations to build confidence.</li><li>• Present academic research communication, including citation standards and bibliographic referencing.</li><li>• Strengthen written French through targeted grammar exercises.</li><li>• Guide students in producing summaries of scientific articles.</li><li>• Enable students to write tailored cover letters and CVs.</li><li>• Prepare students to handle job interviews confidently.</li><li>• Train students to prepare and present internship reports effectively.</li><li>• Teach correct citation of sources.</li><li>• Apply advanced French grammar rules in academic and professional contexts.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  |  |  |  |  |  |  | X |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     | X             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Prerequisite                       | Basic French writing and reading comprehension<br>Familiarity with standard professional formats (CV, letters)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Recommended Texts & Other Readings | <b>Le guide du CV et de la lettre de motivation</b> – Dominique Perez<br><b>L'entretien d'embauche</b> – Danièle Linhart<br><b>La rédaction administrative et professionnelle</b> – Mireille Golaszewski<br><b>Bescherelle</b> – La grammaire pour tous                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |

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| Module                             | GM1.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Module coordinator                 | Olfa Bayoudh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course name                        | English Curriculum                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course teacher                     | Olfa Bayoudh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 21          | 14      |     |                           |     |     | 7             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Description                 | <p><b>The first session:</b><br/>Students are provided with a student’s book prepared by the teacher.<br/>The book is divided up into 4 units. Each unit contains many related texts to the subject<br/><b>Unit One:</b> The History of Chemistry,<br/><b>Unit Two:</b> Glasses and Plastics,<br/><b>Unit Three:</b> Radioactivity, Unit Four: Gases<br/><b>The second session: Oral presentations</b><br/>The second session is devoted to oral presentations. Students are required to prepare a topic of their choice and present it in class. The aim of this session is to improve their speaking skills. Students learn how to take notes during a presentation, how to evaluate and ask questions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>• Develop communication skills across reading, writing, listening, and speaking focused on chemistry content.</li><li>• Use scientific reading passages and technical vocabulary related to chemistry topics.</li><li>• Practice grammar and pronunciation of specialized terms.</li><li>• Interpret and produce charts, diagrams, and descriptions of lab equipment.</li><li>• Master language for instructions, safety, and equipment comparison.</li><li>• Deliver oral presentations on chemistry topics to build fluency and structure technical discourse.</li><li>• Engage in peer evaluation and respond to questions professionally.</li><li>• Read and understand chemistry texts effectively.</li><li>• Describe and compare scientific apparatus clearly.</li><li>• Write coherent paragraphs using appropriate linking words.</li><li>• Follow and give instructions in laboratory settings.</li><li>• Present scientific information confidently in academic and workplace contexts.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  |  |  |  |  |  |  | X |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     | X             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Prerequisite                       | A2–B1 level in English<br>Basic knowledge of chemistry concepts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |
| Recommended Texts & Other Readings | <p>English for the Students of Chemistry – Javad Moini; Oxford English for Careers: Science – Eric H. Glendinning</p> <p>Phonetic alphabet charts and laboratory instruction sheets</p> <p>; English for Chemistry – Lynda Edwards, Tamzin Thompson; Cambridge English for Scientists – Tamzen Armer</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |   |  |  |

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| Module                             | GM1.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Module coordinator                 | Wejda Ochi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Course name                        | Economics and Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Course teacher                     | Wejda Ochi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Year                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Semester                           | S2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 14          | 5       |     |                           |     |     | 2             |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Course Description                 | Chapter No. I: Economic Science<br>Chapter No. II: Economic Growth<br>Chapter No. III: Unemployment<br>Chapter No. IV: Inflation<br>Chapter N°V: The company and its environment<br>Chapter N°VI: The strategic options of companies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Aims and Outcomes                  | <ul style="list-style-type: none"><li>Understand fundamental concepts and analytical tools of economics.</li><li>Define economic science, its functions, agents, and types of economic systems.</li><li>Explain macroeconomic issues including economic growth, unemployment, and inflation.</li><li>Interpret economic indicators such as GDP, GNP, and price indices.</li><li>Analyze causes and effects of macroeconomic phenomena.</li><li>Evaluate public policies addressing economic challenges.</li><li>Define a business and identify its key stakeholders.</li><li>Understand strategic business choices: specialization, diversification, outsourcing, innovation, quality management, and international expansion.</li><li>Analyze how companies adapt strategies to internal and external challenges.</li><li>Apply economic concepts to real-world business and market scenarios.</li></ul> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  |  |  |  |  |  |  |  | X |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               | X    |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Prerequisite                       | None required, though basic social studies or business background is helpful.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Course Requirements                | Internet connection, video projection; means of transport to visit industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |
| Recommended Texts & Other Readings | Introduction à l'économie – Paul A. Samuelson & William D. Nordhaus Économie d'entreprise – Jean-Marc Le Gall, Comprendre l'économie – Philippe Askenazy, INSEE and World Bank reports for real-world economic data and indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |   |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |     |      |      |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|-----|------|------|
| Module                             | GM2.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |     |      |      |
| Module coordinator                 | Hatem Ben Romdhane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |     |      |      |
| Course name                        | Organic Materials                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |     |      |      |
| Course teacher                     | Hatem Ben Romdhane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |     | 3    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Nb of hours |         |     |                           |     |     |               |     |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 21hrs       | 14hrs   |     |                           |     |     | 7hrs          |     |      |      |
| Course Description                 | <p><b>Chapter 1:</b> General Introduction</p> <p><b>Chapter 2:</b> The polymer chain</p> <p><b>Chapter 3:</b> Supramolecular organization</p> <p><b>Chapter 4:</b> The main methods of macromolecular synthesis</p> <p><b>Chapter 5:</b> Polycondensation and polyaddition reactions</p> <p><b>Chapter 6:</b> Radical polymerization</p> <p><b>Chapter 7:</b> Anionic polymerization</p> <p><b>Chapter 8:</b> Cationic polymerization</p> <p><b>Chapter 9:</b> Coordination polymerizations (stereospecific)</p> <p><b>Chapter 10:</b> Industrial polymerization techniques</p> |             |         |     |                           |     |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to provide an in-depth understanding of the structures, synthesis methods, reaction mechanisms, and industrial applications of polymers, linking molecular design to macroscopic properties.                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9 | CS10 | CS11 |
|                                    | xx                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         | X   |                           | x   |     |               |     |      |      |
| Course Structure                   | The course is delivered in-person using lectures including interactive tasks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in the <b>third year of a Licence (L3) in Fundamental or Applied Chemistry</b> , who have successfully completed coursework in <b>organic chemistry, physical chemistry, and general chemistry</b> .                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |     |      |      |
| Course Requirements                | Teacher presence, video projection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |     |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |     |      |      |
| Recommended Texts & Other Readings | <b>Introduction to Polymer Chemistry"</b> – Charles E. Carraher Jr., <b>Organic Materials for Photonics and Electronics"</b> – Chibaya Adachi, Hiroyuki Sasabe; <b>Organic Electronics: Materials, Manufacturing, and Applications"</b> - Hagen Klauk; <b>Handbook of Conducting Polymers"</b> – Terje A. Skotheim & John R. Reynolds; <b>Organic Chemistry of Synthetic High Polymers"</b> – Robert W. Lenz; <b>Principles of Polymer Chemistry"</b> – Paul J. Flory; <b>Polymer Chemistry"</b> – Malcolm P. Stevens                                                           |             |         |     |                           |     |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |                           |               |     |     |     |      |      |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|---------------------------|---------------|-----|-----|-----|------|------|
| Module                             | GM2.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |                           |               |     |     |     |      |      |
| Module coordinator                 | Wadia Dhaoui Ammar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                           |               |     |     |     |      |      |
| Course name                        | Organic Materials Polymers macromolecules                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                           |               |     |     |     |      |      |
| Course teacher                     | Wadia Dhaoui Ammar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                           |               |     |     |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                           |               |     |     |     | 3    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                           |               |     |     |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Nb of hours |         |                           |               |     |     |     |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lecture     | Seminar | Practical Course/Lab work | Personal work |     |     |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 21hrs       | 14hrs   |                           | 7hrs          |     |     |     |      |      |
| Course Description                 | <p><b>First part: Macromolecules.</b></p> <p>Chapter I: Different types of macromolecules/ Chapter 2: Main characteristics of macromolecules/ Chapter 3: Synthesis of macromolecular compounds.</p> <p><b>Part two: Properties of polymers in the solid state.</b></p> <p>Chapter1: Physical properties of polymers</p> <p><b>Third part: The transformation of polymers.</b></p> <p>Chapter I: Introduction – classification of polymers.</p> <p><b>Fourth part :Characteristic study of some common plastics.</b></p> <p>Chapter I: Polyolefins, polyethylenes and polypropylenes PE, PP/ Chapter II: polyvinyl chlorides and their derivatives (PVC)/ Chapter III: styrenics/ Chapter VI: polyacrylics (PMMA)/ Chapter V: fluoropolymers/ Chapter VI: polyoxymethylenes ( POM)/ Chapter VII: polyamides (PA)/ Chapter VIII: polycarbonates./ Chapter IX: thermosets: polyesters, polyurethanes, etc.</p> <p><b>Fifth part: rubbers.</b></p> <p><b>Sixth part: composites.</b></p> |             |         |                           |               |     |     |     |      |      |
| Aims and Outcomes                  | To provide students with a comprehensive understanding of macromolecules and polymers, including their types, synthesis, physical properties, processing methods, and the characteristics of common plastics, rubbers, and composites, enabling them to connect molecular structure to material properties and practical applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |                           |               |     |     |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CS2         | CS3     | CS4                       | CS5           | CS6 | CS7 | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             | XXX     | xxx                       |               | xxx |     |     |      |      |
| Course Structure                   | The course is delivered in-person using lectures including interactive tasks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |                           |               |     |     |     |      |      |
| Prerequisite                       | This course is designed for students in their <b>third year of Licence (L3) in Chemistry, Chemical Engineering, or Materials Science</b> , who have completed foundational courses in <b>organic chemistry, physical chemistry, and general chemistry</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |                           |               |     |     |     |      |      |
| Course Requirements                | Teacher presence, video projection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                           |               |     |     |     |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |                           |               |     |     |     |      |      |
| Recommended Texts & Other Readings | <p><b>"Introduction to Polymers"</b> – Robert J. Young &amp; Peter A. Lovel; <b>Polymer Chemistry"</b> – Malcolm P. Stevens; <b>Principles of Polymerization"</b> – George Odian;; <b>Physical Properties of Polymers Handbook"</b> – James E. Mark (Editor); <b>Polymer Science and Technology"</b> – Joel R. Fried; <b>Plastics Materials"</b> – J.A. Brydson; <b>Rubber Technology Handbook"</b> – Maurice Morton</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |                           |               |     |     |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                       |     |             |     |         |     |                           |     |               |      |      |
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| Module                             | GM2.1                                                                                                                                                                                                                                                                                                                 |     |             |     |         |     |                           |     |               |      |      |
| Module coordinator                 | Adel megrich / Najoua frini Srasra                                                                                                                                                                                                                                                                                    |     |             |     |         |     |                           |     |               |      |      |
| Course name                        | Inorganic Materials                                                                                                                                                                                                                                                                                                   |     |             |     |         |     |                           |     |               |      |      |
| Course teacher                     | Adel megrich / Najoua frini Srasra                                                                                                                                                                                                                                                                                    |     |             |     |         |     |                           |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                     |     |             |     |         |     |                           |     |               | 3    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                     |     |             |     |         |     |                           |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                     |     | Nb of hours |     |         |     |                           |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                    |     | Lecture     |     | Seminar |     | Practical Course/Lab work |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                       |     | 21hrs       |     | 14hrs   |     |                           |     | 7hrs          |      |      |
| Course Description                 | Chapter 1: Elements of Materials Inorganic<br>Chapter 2: Clays: Material First<br>Chapter 3: The glasses<br>Chapter 4: The ceramics<br>Chapter 5: The cements                                                                                                                                                         |     |             |     |         |     |                           |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with a fundamental understanding of inorganic materials, focusing on the composition, structure, properties, and applications of clays, glasses, ceramics, and cements in various industries.                                                                           |     |             |     |         |     |                           |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                   | CS2 | CS3         | CS4 | CS5     | CS6 | CS7                       | CS8 | CS9           | CS10 | CS11 |
|                                    |                                                                                                                                                                                                                                                                                                                       |     |             | xx  |         | xx  |                           |     |               |      |      |
| Course Structure                   | The course is delivered in-person using lectures including interactive tasks                                                                                                                                                                                                                                          |     |             |     |         |     |                           |     |               |      |      |
| Prerequisite                       | This course is intended for students in their <b>second or third year of Licence (L2 or L3)</b> in <b>Materials Science, Chemistry, or Civil Engineering</b> , who have completed foundational courses in <b>general chemistry, inorganic chemistry, and basic materials science</b> .                                |     |             |     |         |     |                           |     |               |      |      |
| Course Requirements                | Teacher presence, video projection                                                                                                                                                                                                                                                                                    |     |             |     |         |     |                           |     |               |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                                                                                                       |     |             |     |         |     |                           |     |               |      |      |
| Recommended Texts & Other Readings | Materials Science and Engineering: An Introduction – William D. Callister Jr.<br>Introduction to Ceramics – W. David Kingery, H. K. Bowen, D. R. Uhlmann<br>Glass Science – Robert H. Doremus<br>The Chemistry of Cement and Concrete – F.M. Lea<br>Clay Minerals: Their Structure, Behaviour and Use – R. J. Hillier |     |             |     |         |     |                           |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                      |     |             |         |                           |     |     |               |      |      |
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| Module                             | GM2.1                                                                                                                                                                                                                                                                                                                                                |     |             |         |                           |     |     |               |      |      |
| Module coordinator                 | Hatem Ben Romdhane                                                                                                                                                                                                                                                                                                                                   |     |             |         |                           |     |     |               |      |      |
| Course name                        | TP Materials                                                                                                                                                                                                                                                                                                                                         |     |             |         |                           |     |     |               |      |      |
| Course teacher                     | Amani Chouchane                                                                                                                                                                                                                                                                                                                                      |     |             |         |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                    |     |             |         |                           |     |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                    |     |             |         |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                    |     | Nb of hours |         |                           |     |     |               |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                   |     | Lecture     | Seminar | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                      |     |             |         | 14hrs                     |     |     | 14hrs         |      |      |
| Course Description                 | TP Materials<br>Manipulation No. I: Synthesis of a conductive polymer: polyaniline<br>Manipulation No. II: interfacial polycondensation<br>Manipulation No. III: Synthesis of PMMA and polystyrene by radical route<br>Handling No. IV: Physico-chemical characterizations of some polymers<br>Manipulation No. V: Differential scanning calorimetry |     |             |         |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to equip students with practical skills in synthesizing and characterizing polymers, including conductive polymers, radical polymerization, interfacial polycondensation, and thermal analysis techniques like differential scanning calorimetry.                                                                          |     |             |         |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                  | CS2 | CS3         | CS4     | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                      |     |             | xx      |                           | xx  |     |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                              |     |             |         |                           |     |     |               |      |      |
| Prerequisite                       | This course is designed for students in their third year of Licence (L3) in Chemistry, Materials Science, or Chemical Engineering, who have completed foundational courses in polymer chemistry, organic chemistry, and physical chemistry.                                                                                                          |     |             |         |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                     |     |             |         |                           |     |     |               |      |      |
| Required text                      | Lab sheets                                                                                                                                                                                                                                                                                                                                           |     |             |         |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | Introduction to Polymers – Robert J. Young & Peter A. Lovell<br>Polymer Chemistry – Malcolm P. Stevens<br>Principles of Polymerization – George Odian<br>Physical Properties of Polymers Handbook – James E. Mark (Editor)                                                                                                                           |     |             |         |                           |     |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |             |         |                            |     |               |     |      |      |
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| Module                             | GM2.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |             |         |                            |     |               |     |      |      |
| Module coordinator                 | Yousef arfaoui                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |             |         |                            |     |               |     |      |      |
| Course name                        | NMR analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |             |         |                            |     |               |     |      |      |
| Course teacher                     | Yousef arfaoui                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |             |         |                            |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |             |         |                            |     |               |     | 3    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |             |         |                            |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     | Nb of hours |         |                            |     |               |     |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     | Lecture     | Seminar | Practical Course /Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     | 21hrs       | 14hrs   |                            |     | 7hrs          |     |      |      |
| Course Description                 | <p><b>Chapter I:</b> Nuclear magnetic resonance phenomenon</p> <p><b>Chapter II:</b> Main quantities measurable in NMR: <math>\delta</math> , J</p> <p><b>Chapter III:</b> analysis of high resolution NMR spectra</p> <p><b>Chapter IV:</b> NMR spectrometers</p> <p><b>Chapter V:</b> Double resonance and chemical shift reagents</p> <p><b>Chapter VI:</b> Examples of high-resolution NMR applications</p> <p><b>Chapter VII:</b> Applications of NMR to quantitative analysis</p> <p><b>Chapter VIII:</b> Multi-pulse and two-dimensional NMR experiment (Elementary notions)</p> <p><b>Chapter IX:</b> Applications of NMR to the elucidation of molecular structures</p> |     |             |         |                            |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with a thorough understanding of nuclear magnetic resonance (NMR) principles, instrumentation, spectral analysis, and its applications in molecular structure elucidation and quantitative analysis.                                                                                                                                                                                                                                                                                                                                                                                                                               |     |             |         |                            |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CS2 | CS3         | CS4     | CS5                        | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     | xx          |         |                            |     | xx            |     |      |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive tasks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |             |         |                            |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Chemistry or Chemical Engineering, who have completed foundational courses in physical chemistry, organic chemistry, and instrumental analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |             |         |                            |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |             |         |                            |     |               |     |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |             |         |                            |     |               |     |      |      |
| Recommended Texts & Other Readings | High-Resolution NMR Techniques in Organic Chemistry – Timothy D.W. Claridge<br>Spin Dynamics: Basics of Nuclear Magnetic Resonance – Malcolm H. Levitt<br>NMR Spectroscopy: Basic Principles, Concepts, and Applications in Chemistry – Harald Günther<br>Understanding NMR Spectroscopy – James Keeler                                                                                                                                                                                                                                                                                                                                                                          |     |             |         |                            |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                     |         |             |     |                           |     |     |               |      |      |
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| Module                             | GM2.2                                                                                                                                                                                                                               |         |             |     |                           |     |     |               |      |      |
| Module coordinator                 | Fethi Oueslati                                                                                                                                                                                                                      |         |             |     |                           |     |     |               |      |      |
| Course name                        | Mass spectrometry                                                                                                                                                                                                                   |         |             |     |                           |     |     |               |      |      |
| Course teacher                     | Fethi Oueslati                                                                                                                                                                                                                      |         |             |     |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                   |         |             |     |                           |     |     |               | 3    |      |
| Semester                           | 1                                                                                                                                                                                                                                   |         |             |     |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                   |         | Nb of hours |     |                           |     |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                  | Lecture | Seminar     |     | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                     | 21hrs   | 14hrs       |     |                           |     |     | 7hrs          |      |      |
| Course Description                 | <b>Chapter I:</b> Introduction to mass spectrometry<br><b>Chapter II:</b> Ionization by electronic impact<br><b>Chapter III:</b> Other ionization methods                                                                           |         |             |     |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to the fundamental principles of mass spectrometry, including various ionization techniques such as electron impact and other advanced ionization methods.                          |         |             |     |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                 | CS2     | CS3         | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                     |         | xx          |     |                           |     | xx  |               |      |      |
|                                    |                                                                                                                                                                                                                                     |         |             |     |                           |     |     |               |      |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive tasks                                                                                                                                                         |         |             |     |                           |     |     |               |      |      |
| Prerequisite                       | This course is designed for students in their second or third year of Licence (L2 or L3) in Chemistry or Chemical Engineering, with prior knowledge of general chemistry and basic analytical techniques.                           |         |             |     |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                    |         |             |     |                           |     |     |               |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                     |         |             |     |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | Mass Spectrometry: Principles and Applications – Edmond de Hoffmann & Vincent Stroobant<br>Introduction to Mass Spectrometry – J. Throck Watson & O. David Sparkman<br>Mass Spectrometry for the Novice – John Greaves & John Roboz |         |             |     |                           |     |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                           |     |             |         |                           |     |     |               |      |      |
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| Module                             | GM2.2                                                                                                                                                                                                                                                     |     |             |         |                           |     |     |               |      |      |
| Module coordinator                 | Soussen Namouchi                                                                                                                                                                                                                                          |     |             |         |                           |     |     |               |      |      |
| Course name                        | X-RAY ANALYZES                                                                                                                                                                                                                                            |     |             |         |                           |     |     |               |      |      |
| Course teacher                     | Soussen Namouchi                                                                                                                                                                                                                                          |     |             |         |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                         |     |             |         |                           |     |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                         |     |             |         |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                         |     | Nb of hours |         |                           |     |     |               |      |      |
|                                    | 28                                                                                                                                                                                                                                                        |     | Lecture     | Seminar | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                           |     | 14hrs       | 5hrs    |                           |     |     | 9hrs          |      |      |
| Course Description                 | <p><b>Chapter I:</b> X-ray fluorescence</p> <p><b>Chapter II:</b> X-RAY DIFFRACTION</p>                                                                                                                                                                   |     |             |         |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with foundational knowledge of X-ray fluorescence and X-ray diffraction techniques, focusing on their principles, instrumentation, and applications for material characterization.                          |     |             |         |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                       | CS2 | CS3         | CS4     | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                           |     | xxx         | xxx     |                           |     | XXX |               |      |      |
|                                    |                                                                                                                                                                                                                                                           |     |             |         |                           |     |     |               |      |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive tasks                                                                                                                                                                               |     |             |         |                           |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Chemistry, Materials Science, or Physics, who have completed foundational courses in general chemistry, inorganic chemistry, and basic analytical techniques. |     |             |         |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                          |     |             |         |                           |     |     |               |      |      |
| Required text                      | Prepared course                                                                                                                                                                                                                                           |     |             |         |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | <p>Introduction to X-Ray Spectrometry – Ron Jenkins</p> <p>Elements of X-Ray Diffraction – B. D. Cullity</p> <p>X-Ray Diffraction Procedures – Harold P. Klug &amp; Leroy E. Alexander</p>                                                                |     |             |         |                           |     |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                   |     |             |     |         |     |                           |     |               |      |
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| Module                             | GM2.2                                                                                                                                                                                                                                             |     |             |     |         |     |                           |     |               |      |
| Module coordinator                 | Monia Hichri                                                                                                                                                                                                                                      |     |             |     |         |     |                           |     |               |      |
| Course name                        | Thermal analysis                                                                                                                                                                                                                                  |     |             |     |         |     |                           |     |               |      |
| Course teacher                     | Monia Hichri                                                                                                                                                                                                                                      |     |             |     |         |     |                           |     | ECTS          |      |
| Year                               | 2                                                                                                                                                                                                                                                 |     |             |     |         |     |                           |     | 1             |      |
| Semester                           | 2                                                                                                                                                                                                                                                 |     |             |     |         |     |                           |     |               |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                 |     | Nb of hours |     |         |     |                           |     |               |      |
|                                    | 21                                                                                                                                                                                                                                                |     | Lecture     |     | Seminar |     | Practical Course/Lab work |     | Personal work |      |
|                                    |                                                                                                                                                                                                                                                   |     | 14hrs       |     | 5hrs    |     |                           |     | 2hrs          |      |
| Course Description                 | <b>Chapter I:</b> Introduction to thermal analysis methods presentation and conventions<br><b>Chapter II:</b> Thermogravimetry<br><b>Chapter III:</b> Differential thermal analysis<br><b>Chapter IV:</b> Calorimetry                             |     |             |     |         |     |                           |     |               |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to thermal analysis techniques, including thermogravimetry, differential thermal analysis, and calorimetry, emphasizing their principles, methods, and applications in material characterization. |     |             |     |         |     |                           |     |               |      |
|                                    | CS1                                                                                                                                                                                                                                               | CS2 | CS3         | CS4 | CS5     | CS6 | CS7                       | CS8 | CS9           | CS10 |
|                                    |                                                                                                                                                                                                                                                   |     | XXX         | xxx |         | xxx |                           |     |               |      |
|                                    |                                                                                                                                                                                                                                                   |     |             |     |         |     |                           |     |               |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                           |     |             |     |         |     |                           |     |               |      |
| Prerequisite                       | This course is designed for students in their third year of Licence (L3) in Chemistry, Materials Science, or Chemical Engineering, who have completed foundational courses in polymer chemistry, organic chemistry, and physical chemistry.       |     |             |     |         |     |                           |     |               |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                  |     |             |     |         |     |                           |     |               |      |
| Required text                      | Lab sheets                                                                                                                                                                                                                                        |     |             |     |         |     |                           |     |               |      |
| Recommended Texts & Other Readings | Introduction to Polymers – Robert J. Young & Peter A. Lovell<br>Polymer Chemistry – Malcolm P. Stevens<br>Principles of Polymerization – George Odian<br>Physical Properties of Polymers Handbook – James E. Mark (Editor)                        |     |             |     |         |     |                           |     |               |      |

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| Module                             | GM2.3                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |
| Module coordinator                 | Chiraz Hannachi                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |
| Course name                        | Separation methods                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |
| Course teacher                     | Chiraz Hannachi                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     | 3    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                         | Nb of hours |         |     |                           |     |               |     |      |      |
|                                    | 42                                                                                                                                                                                                                                                                        | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                           | 14hrs       | 5hrs    |     |                           |     | 2hrs          |     |      |      |
| Course Description                 | <p><b>Chapter I:</b> Separation by selective precipitation</p> <p><b>Chapter II:</b> Separation by ion exchange</p> <p><b>Chapter III:</b> Separation by liquid-liquid extraction</p>                                                                                     |             |         |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with theoretical and practical knowledge of classical separation techniques, including selective precipitation, ion exchange, and liquid-liquid extraction, and their applications in analytical and preparative chemistry. |             |         |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                       | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    | xx                                                                                                                                                                                                                                                                        |             |         |     | xx                        | xx  |               |     |      |      |
|                                    |                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                   |             |         |     |                           |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Chemistry, who have completed foundational courses in general chemistry, analytical chemistry, and solution equilibria.                                                       |             |         |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | Quantitative Chemical Analysis – Daniel C. Harris<br>Principles of Instrumental Analysis – Douglas A. Skoog, F. James Holler, Stanley R. Crouch<br>Analytical Chemistry – Gary D. Christian                                                                               |             |         |     |                           |     |               |     |      |      |

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| Module                             | GM2.3                                                                                                                                                                                                                                                                                                                                            |             |         |     |     |                           |     |               |      |      |
| Module coordinator                 | Monia Hichri                                                                                                                                                                                                                                                                                                                                     |             |         |     |     |                           |     |               |      |      |
| Course name                        | Chromatography                                                                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |               |      |      |
| Course teacher                     | Monia Hichri                                                                                                                                                                                                                                                                                                                                     |             |         |     |     |                           |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                |             |         |     |     |                           |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                |             |         |     |     |                           |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                | Nb of hours |         |     |     |                           |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                                               | Lecture     | Seminar |     |     | Practical Course/Lab work |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                  | 28hrs       | 14hrs   |     |     |                           |     | 7hrs          |      |      |
| Course Description                 | <b>Chapter I:</b> Chromatographic methods<br><b>Chapter II:</b> Gas chromatography<br><b>Chapter III:</b> Liquid phase chromatography on column (Adsorption, partitioning, ion exchange, exclusion)<br><b>Chapter IV:</b> Optimization<br><b>Chapter V :</b> Size exclusion chromatography<br><b>Chapter VI:</b> Ion exchange chromatography     |             |         |     |     |                           |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with a comprehensive understanding of chromatographic separation techniques, including gas and liquid chromatography, and to develop their ability to optimize and apply various modes such as adsorption, partitioning, ion exchange, and size exclusion for analytical and preparative purposes. |             |         |     |     |                           |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                              | CS2         | CS3     | CS4 | CS5 | CS6                       | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                  |             | XXX     |     |     |                           | xxx | xxx           |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                  |             |         |     |     |                           |     |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                          |             |         |     |     |                           |     |               |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Chemistry or related fields, who have completed foundational courses in analytical chemistry, physical chemistry, and instrumental analysis.                                                                                                                         |             |         |     |     |                           |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                |             |         |     |     |                           |     |               |      |      |
| Recommended Texts & Other Readings | Chromatography: Concepts and Contrasts – James M. Miller<br>Introduction to Modern Liquid Chromatography – Lloyd R. Snyder, Joseph J. Kirkland, John W. Dolan<br>Gas Chromatography and Mass Spectrometry – James W. Perry, Harold M. McNair<br>Principles and Practice of Chromatography – R.P.W. Scott                                         |             |         |     |     |                           |     |               |      |      |

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| Module                             | GM2.3                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |
| Module coordinator                 | Dorra Tabassi                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |
| Course name                        | TP Separation method                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |
| Course teacher                     | Dorra Tabassi                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                           | Nb of hours |         |     |                           |     |     |               |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     | 14hrs                     |     |     | 14hrs         |      |      |
| Course Description                 | <p><b>Manipulation No. I:</b> Selective precipitation.<br/>Separation of iron III, copper II and zinc ions.</p> <p><b>Manipulation No. II:</b> Separation by ion exchange.</p> <p><b>Manipulation No. III:</b> Separation of cations using ion exchange resins.</p> <p><b>Manipulation No. IV:</b> Separation by extraction.<br/>Extraction of metal chelates.</p> <p><b>Handling No. V:</b> Separation of iron and aluminum by extraction of chelates.</p> |             |         |     |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to train students in classical separation techniques through practical laboratory work, focusing on selective precipitation, ion exchange, and liquid-liquid extraction methods for the separation and purification of metal ions                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | XXX     |     |                           |     | xxx | xxx           |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Chemistry, who have completed laboratory and theoretical courses in general chemistry, analytical chemistry, and inorganic chemistry.                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | Quantitative Chemical Analysis – Daniel C. Harris<br>Analytical Chemistry – Gary D. Christian<br>Principles of Analytical Chemistry – Miguel Valcárcel<br>Principles of Instrumental Analysis – Douglas A. Skoog, F. James Holler, Stanley R. Crouch                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |

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| Module                             | GM2.4                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |
| Module coordinator                 | Mohamed Lotfi Efrit                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |
| Course name                        | PHARMACEUTICAL CHEMISTRY                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |
| Course teacher                     | Mohamed Lotfi Efrit                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     | 1    |      |
| Semester                           | 1                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                            | Nb of hours |         |     |                           |     |               |     |      |      |
|                                    | 21                                                                                                                                                                                                                                                           | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                              | 14          | 5       |     |                           |     | 2             |     |      |      |
| Course Description                 | <b>Chapter I:</b> Introduction to knowledge of medicine<br><b>Chapter II:</b> Bioisosteres<br><b>Chapter III:</b> Structure-Activity Relationship<br><b>Chapter VI:</b> The main therapeutic classes of drugs                                                |             |         |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to fundamental concepts in medicinal chemistry, including bioisosterism, structure-activity relationships, and an overview of major therapeutic drug classes.                                                |             |         |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                          | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    | xx                                                                                                                                                                                                                                                           |             | xx      |     | xx                        | xx  |               | xx  |      |      |
|                                    |                                                                                                                                                                                                                                                              |             |         |     |                           |     |               |     |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                      |             |         |     |                           |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Chemistry, Pharmacy, or Biomedical Sciences, who have completed foundational courses in organic chemistry and biochemistry.                                                      |             |         |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                             |             |         |     |                           |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | Medicinal Chemistry – Gareth Thomas<br>An Introduction to Medicinal Chemistry – Graham L. Patrick<br>Essentials of Medicinal Chemistry – Andrew R. Leach & Valerie J. Gillet<br>Burger’s Medicinal Chemistry and Drug Discovery – Donald J. Abraham (Editor) |             |         |     |                           |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |
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| Module                             | GM2.4                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |
| Module coordinator                 | Sadok Boukchina                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |
| Course name                        | Biochemistry                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |
| Course teacher                     | Sadok Boukchina                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               | 3    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                       | Nb of hours |         |     |                           |     |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                      | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                         | 21          | 14      |     |                           |     |     | 7             |      |      |
| Course Description                 | Chapter I: Structural Biochemistry<br>Chapter II: Metabolic biochemistry and enzymology<br>Chapter III: biochemistry                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with a solid foundation in structural and metabolic biochemistry, enzymology, and the practical applications of biochemical principles in various fields.                                                                                                                 |             |         |     |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                     | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    | xx                                                                                                                                                                                                                                                                                                                      |             |         |     | xx                        | xx  |     |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Biology, Biochemistry, or related life sciences, who have completed foundational courses in general biology and organic chemistry.                                                                                                          |             |         |     |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | erg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. <i>Biochemistry</i> , 9th Edition. W.H. Freeman & Company, 2019.<br><br>Voet, D., Voet, J. G. <i>Biochemistry</i> , 5th Edition. Wiley, 2011.<br><br>Nelson, D. L., & Cox, M. M. <i>Lehninger Principles of Biochemistry</i> , 8th Edition. W.H. Freeman, 2021. |             |         |     |                           |     |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |
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| Module                             | GM2.4                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |               |     |      |      |
| Module coordinator                 | Mabrouk Horchani                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |               |     |      |      |
| Course name                        | Pharmaceutical Chemistry TP                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |
| Course teacher                     | Mabrouk Horchani                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                     | Nb of hours |         |     |                           |     |               |     |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                    | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     | 14                        |     | 14            |     |      |      |
| Course Description                 | <b>Handling No. I:</b> Synthesis of a preservative: propylparaben<br><b>Manipulation No. II:</b> Preparation of acetylsalicylic acid (aspirin)<br><b>Manipulation No. III:</b> Preparation of paracetamol<br><b>Manipulation No. IV:</b> Dosage of a doliprane tablet<br><b>Handling No. V:</b> Preparation of phenacetin<br><b>Manipulation No. VI:</b> Preparation of phenylacetone |             |         |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with practical laboratory experience in the synthesis and analysis of pharmaceutical compounds, focusing on the preparation of common drugs and dosage determination techniques.                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                   | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                       |             | xx      |     | xx                        | xx  |               | xx  |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Chemistry, Pharmacy, or related fields, who have completed courses in organic chemistry and analytical chemistry.                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | Organic Chemistry – Paula Yurkanis Bruice<br>Pharmaceutical Chemistry – David G. Watson<br>Vogel’s Textbook of Practical Organic Chemistry – Arthur R. Tatchell<br>Pharmaceutical Analysis – David G. Watson                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |

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| Module                             | GM2.5                                                                                                                                                                                                                                       |             |         |                            |     |     |     |               |      |      |
| Module coordinator                 | Rachida Badira                                                                                                                                                                                                                              |             |         |                            |     |     |     |               |      |      |
| Course name                        | Instrumentation I                                                                                                                                                                                                                           |             |         |                            |     |     |     |               |      |      |
| Course teacher                     | Rachida Badira                                                                                                                                                                                                                              |             |         |                            |     |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                           |             |         |                            |     |     |     |               | 1    |      |
| Semester                           | 2                                                                                                                                                                                                                                           |             |         |                            |     |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                           | Nb of hours |         |                            |     |     |     |               |      |      |
|                                    | 21                                                                                                                                                                                                                                          | Lecture     | Seminar | Practical Course /Lab work |     |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                             | 14hrs       | 5hrs    |                            |     |     |     | 2hrs          |      |      |
| Course Description                 | CHAPTER I: C hatred of measure<br>CHAPTER II: ANALOG MEASURING DEVICES<br>CHAPTER III: THE SENSORS<br>CHAPTER IV: THERMOMETERS                                                                                                              |             |         |                            |     |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to the principles of measurement systems, focusing on analog measuring devices, sensor technologies, and temperature measurement using thermometers.                                        |             |         |                            |     |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                         | CS2         | CS3     | CS4                        | CS5 | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    | x                                                                                                                                                                                                                                           |             |         |                            |     |     | xxx |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                     |             |         |                            |     |     |     |               |      |      |
| Prerequisite                       | this course is intended for students in their second or third year of Licence (L2 or L3) in Physics, Instrumentation, or Applied Sciences, who have completed foundational courses in electricity, electronics, and general physics.        |             |         |                            |     |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                            |             |         |                            |     |     |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                           |             |         |                            |     |     |     |               |      |      |
| Recommended Texts & Other Readings | Measurement Systems: Application and Design – Ernest O. Doebelin<br>Principles of Measurement Systems – John P. Bentley<br>Introduction to Instrumentation and Measurements – Robert B. Northrop<br>Sensors and Transducers – D. Patranabis |             |         |                            |     |     |     |               |      |      |

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| Module                             | GM2.5                                                                                                                                                                                                                                                                                                                                  |             |         |                           |     |     |     |               |      |      |
| Module coordinator                 | Amira Zaatour Anene                                                                                                                                                                                                                                                                                                                    |             |         |                           |     |     |     |               |      |      |
| Course name                        | Instrumentation II                                                                                                                                                                                                                                                                                                                     |             |         |                           |     |     |     |               |      |      |
| Course teacher                     | Amira Zaatour Anene                                                                                                                                                                                                                                                                                                                    |             |         |                           |     |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     |     |               | 1    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                      | Nb of hours |         |                           |     |     |     |               |      |      |
|                                    | 21                                                                                                                                                                                                                                                                                                                                     | Lecture     | Seminar | Practical Course/Lab work |     |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                        | 14          | 5       |                           |     |     |     | 2             |      |      |
| Course Description                 | <b>Chapter I:</b> Theoretical and practical aspects of chromatography<br><b>Chapter II:</b> Gas chromatography<br><b>Chapter III:</b> Liquid chromatography<br><b>Chapter IV:</b> Mass spectrometry                                                                                                                                    |             |         |                           |     |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with both theoretical and practical knowledge of chromatography and mass spectrometry, focusing on their principles, instrumentation, and applications in chemical analysis.                                                                                                             |             |         |                           |     |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                    | CS2         | CS3     | CS4                       | CS5 | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    | x                                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     | xxx |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                |             |         |                           |     |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their third year of Licence (L3) in Chemistry or Analytical Sciences, who have completed foundational courses in analytical chemistry, instrumental analysis, and physical chemistry.                                                                                                          |             |         |                           |     |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                       |             |         |                           |     |     |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     |     |               |      |      |
| Recommended Texts & Other Readings | Chromatography: Concepts and Contrasts – James M. Miller<br>Introduction to Modern Liquid Chromatography – Lloyd R. Snyder, Joseph J. Kirkland, John W. Dolan<br>Gas Chromatography and Mass Spectrometry – James W. Perry, Harold M. McNair<br>Mass Spectrometry: Principles and Applications – Edmond de Hoffmann, Vincent Stroobant |             |         |                           |     |     |     |               |      |      |

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| Module                             | GM2.5                                                                                                                                                                                                                                                                                                                          |             |         |                           |     |     |     |               |      |      |
| Module coordinator                 | Hajer Maghraoui                                                                                                                                                                                                                                                                                                                |             |         |                           |     |     |     |               |      |      |
| Course name                        | Metrology                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     |     |               |      |      |
| Course teacher                     | Hajer Maghraoui                                                                                                                                                                                                                                                                                                                |             |         |                           |     |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                              |             |         |                           |     |     |     |               | 3    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                              |             |         |                           |     |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                              | Nb of hours |         |                           |     |     |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                             | Lecture     | Seminar | Practical Course/Lab work |     |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                | 21          | 14      |                           |     |     |     | 7             |      |      |
| Course Description                 | <b>Chapter 1:</b> Introduction to metrology<br><b>Chapter 2:</b> General information on sensors/or the acquisition of a greatness<br><b>Chapter 3:</b> Sensors: conditioners associates<br><b>Chapter 4:</b> Sensors Temperature<br><b>Chapter 5:</b> Sensors humidity<br><b>Chapter 6:</b> Measurement and Detection of level |             |         |                           |     |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to the fundamentals of metrology and sensor technology, focusing on the acquisition and conditioning of physical measurements such as temperature, humidity, and level detection.                                                                                              |             |         |                           |     |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                            | CS2         | CS3     | CS4                       | CS5 | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    | x                                                                                                                                                                                                                                                                                                                              |             | xx      |                           |     |     | xxx |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                        |             |         |                           |     |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Instrumentation, Physics, or Applied Sciences, who have completed foundational courses in general physics, electronics, and measurement systems                                                                                    |             |         |                           |     |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                               |             |         |                           |     |     |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                              |             |         |                           |     |     |     |               |      |      |
| Recommended Texts & Other Readings | Measurement Systems: Application and Design – Ernest O. Doebelin<br>Principles of Measurement Systems – John P. Bentley<br>Sensors and Transducers – D. Patranabis<br>Introduction to Instrumentation and Measurements – Robert B. Northrop                                                                                    |             |         |                           |     |     |     |               |      |      |

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| Module                             | GM2.5                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |
| Module coordinator                 | Oussama Riahi                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |
| Course name                        | TP Instrumentation and metrology                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |
| Course teacher                     | Oussama Riahi                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                            | Nb of hours |         |     |                           |     |     |               |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                           | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                              |             |         |     | 14hrs                     |     |     | 14hrs         |      |      |
| Course Description                 | TP Metrology<br>Handling No. I: Measuring lengths<br>Handling No. II: Weighing & Mass Measurement<br>Manipulation No. III: Density measurement<br>Handling No. IV: Temperature measurement<br>Instrumentation TP<br>Manipulation No. I: Balance<br>Handling No. II: Voltmeter ampermeter<br>Handling No. III: Different types of thermometer |             |         |     |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to develop students' practical skills in basic metrology and instrumentation, focusing on the accurate measurement of physical quantities such as length, mass, density, temperature, voltage, and current using standard laboratory equipment.                                                                    |             |         |     |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                          | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     | xxx |               |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second year of Licence (L2) in Physics, Instrumentation, or Applied Sciences, who have completed introductory courses in general physics, measurement techniques, and basic electronics.                                                                                                       |             |         |     |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |
| Required text                      | Lab sheets                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | Measurement Systems: Application and Design – Ernest O. Doebelin<br>Principles of Measurement Systems – John P. Bentley<br>Introduction to Instrumentation and Measurements – Robert B. Northrop<br>Basic Metrology for ISO 9000 Certification – T. H. Bell                                                                                  |             |         |     |                           |     |     |               |      |      |

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| Module                             | GM2.5                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |               |     |      |      |
| Module coordinator                 | Rachida Bedira                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     |      |      |
| Course name                        | Electronics TP                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     |      |      |
| Course teacher                     | Rachida Bedira                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |               |     | 2    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                 | Nb of hours |         |     |                           |     |               |     |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                   |             |         |     | 14hrs                     |     | 14hrs         |     |      |      |
| Course Description                 | <b>Electronics TP</b><br><b>Manipulation No. I:</b> General theorems<br><b>Manipulation No. II:</b> Quadrupoles and linear filters<br><b>Handling No. III:</b> Diodes and Diode Circuits<br><b>Handling No. IV:</b> Bipolar transistor<br><b>Manipulation No. V:</b> Field effect transistor<br><b>Manipulation No. VI:</b> Operational amplifier |             |         |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to provide students with hands-on experience in fundamental electronic components and circuits, including the application of general theorems, analysis of filters and quadrupoles, and the practical use of diodes, transistors, and operational amplifiers.                                                           |             |         |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                               | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     | xxx           |     |      |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks                                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Electronics, Physics, or Electrical Engineering, who have completed foundational courses in electric circuits, semiconductor physics, and analog electronics.                                                                                         |             |         |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |               |     |      |      |
| Required text                      | Lab sheets                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | Electronic Devices and Circuit Theory – Robert L. Boylestad, Louis Nashelsky<br>Microelectronic Circuits – Adel S. Sedra, Kenneth C. Smith<br>Electronic Principles – Albert Malvino, David Bates<br>The Art of Electronics – Paul Horowitz, Winfield Hill                                                                                        |             |         |     |                           |     |               |     |      |      |

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| Module                             | GM2.6                                                                                                                                                                                                                                                                                                                                             |             |         |     |                            |     |     |               |     |      |      |
| Module coordinator                 | Adel Agrebi                                                                                                                                                                                                                                                                                                                                       |             |         |     |                            |     |     |               |     |      |      |
| Course name                        | Computer science                                                                                                                                                                                                                                                                                                                                  |             |         |     |                            |     |     |               |     |      |      |
| Course teacher                     | Adel Agrebi                                                                                                                                                                                                                                                                                                                                       |             |         |     |                            |     |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                            |     |     |               |     | 1    |      |
| Semester                           | 1                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                            |     |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                 | Nb of hours |         |     |                            |     |     |               |     |      |      |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                | Lecture     | Seminar |     | Practical Course /Lab work |     |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                   | 14hrs       | 5hrs    |     |                            |     |     | 2hrs          |     |      |      |
| Course Description                 | <b>Computer science</b><br><b>Chapter 1:</b> Introduction to chemoinformatics<br><b>Chapter 2:</b> The MATLAB environment<br><b>Chapter 3:</b> Vectors and Matrices in MATLAB<br><b>Chapter 4:</b> Programming in MATLAB<br><b>Chapter 5:</b> Approximations and resolutions of systems<br><b>Chapter 6:</b> Introduction to Relational Databases |             |         |     |                            |     |     |               |     |      |      |
| Aims and Outcomes                  | The aim of this course is to introduce students to the fundamentals of chemoinformatics, numerical computing, and data management through the use of MATLAB and relational databases, with a focus on problem-solving, programming, and chemical data processing.                                                                                 |             |         |     |                            |     |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                               | CS2         | CS3     | CS4 | CS5                        | CS6 | CS7 | CS8           | CS9 | CS10 | CS11 |
|                                    |                                                                                                                                                                                                                                                                                                                                                   | x           |         |     |                            |     |     |               |     | xx   |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive taskss                                                                                                                                                                                                                                                                      |             |         |     |                            |     |     |               |     |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Chemistry, Bioinformatics, or Applied Sciences, who have completed foundational courses in general computer science, mathematics (linear algebra and calculus), and basic programming concepts.                                                       |             |         |     |                            |     |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                  |             |         |     |                            |     |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                 |             |         |     |                            |     |     |               |     |      |      |
| Recommended Texts & Other Readings | MATLAB for Engineers – Holly Moore<br>Essential MATLAB for Engineers and Scientists – Brian Hahn, Daniel T. Valentine<br>An Introduction to Chemoinformatics – Andrew R. Leach, Valerie J. Gillet<br>Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan                                                                |             |         |     |                            |     |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |
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| Module                             | GM2.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |
| Module coordinator                 | Faten el Meddah                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |
| Course name                        | Metrology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |
| Course teacher                     | Faten el Meddah                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               | 2    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Nb of hours |         |     |                           |     |     |               |      |      |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     | 14hrs                     |     |     | 14hrs         |      |      |
| Course Description                 | <b>IT practical work</b><br><b>Manipulation No. I :: Introduction</b> to the MATLAB environment, the exploitation of the interface, direct application of course examples on basic data processing instructions.<br><b>Manipulation No. II</b> : Vector and matrix calculation.<br><b>Manipulation No. III</b> : Tracing, saving and exporting 2D and 3D graphics.<br><b>Handling N°IV</b> : Programming in MATLAB and creation of batteries of M-files type functions.<br><b>Manipulation No. V</b> : Resolution of a linear interpolation problem.<br><b>Handling No. VI</b> : Solving a linear regression problem. |             |         |     |                           |     |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to develop students' practical skills in scientific computing using MATLAB, with hands-on experience in data processing, matrix operations, graphical visualization, programming with M-files, and solving basic numerical problems such as interpolation and regression                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | x           |         |     |                           |     |     |               |      | XX   |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in Chemistry, Physics, or Applied Sciences, who have completed introductory courses in mathematics (especially linear algebra), general computer science, and basic programming.                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |
| Required text                      | Programmed course and exercise sheets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |
| Recommended Texts & Other Readings | MATLAB for Engineers – Holly Moore<br>Essential MATLAB for Engineers and Scientists – Brian Hahn, Daniel T. Valentine<br>MATLAB: A Practical Introduction to Programming and Problem Solving – Stormy Attaway<br>Numerical Methods Using MATLAB – John H. Mathews, Kurtis D. Fink                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                                      |         |             |         |     |                           |     |               |      |      |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------|---------|-----|---------------------------|-----|---------------|------|------|
| Module                             | GM2.6                                                                                                                                                                                                                                                                |         |             |         |     |                           |     |               |      |      |
| Module coordinator                 | Olfa Bayoudh Chaari                                                                                                                                                                                                                                                  |         |             |         |     |                           |     |               |      |      |
| Course name                        | Communications techniques                                                                                                                                                                                                                                            |         |             |         |     |                           |     |               |      |      |
| Course teacher                     | Olfa Bayoudh Chaari                                                                                                                                                                                                                                                  |         |             |         |     |                           |     |               | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                    |         |             |         |     |                           |     |               | 3    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                    |         |             |         |     |                           |     |               |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                    |         | Nb of hours |         |     |                           |     |               |      |      |
|                                    | 42                                                                                                                                                                                                                                                                   | Lecture |             | Seminar |     | Practical Course/Lab work |     | Personal work |      |      |
|                                    |                                                                                                                                                                                                                                                                      | 21hrs   |             | 14hrs   |     |                           |     | 7hrs          |      |      |
| Course Description                 | Communications techniques<br>Chapter I: Communication<br>Chapter II: Recruitment<br>Chapter III: Oral communication<br>Chapter IV: The end-of-studies project<br>Chapter V: Reminders for writing correctly                                                          |         |             |         |     |                           |     |               |      |      |
| Aims and Outcomes                  | The aim of this course is to enhance students' communication skills in academic and professional contexts, focusing on effective oral and written communication, recruitment preparation, and the successful planning and presentation of an end-of-studies project. |         |             |         |     |                           |     |               |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                  | CS2     | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8           | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                      |         |             |         |     |                           |     |               | xx   |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive tasks                                                                                                                                                                                          |         |             |         |     |                           |     |               |      |      |
| Prerequisite                       | This course is intended for students in their second or third year of Licence (L2 or L3) in any scientific or technical field, who have completed foundational courses in general communication, report writing, and basic project methodology.                      |         |             |         |     |                           |     |               |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                     |         |             |         |     |                           |     |               |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                    |         |             |         |     |                           |     |               |      |      |
| Recommended Texts & Other Readings | Business Communication Today – Courtland L. Bovee, John V. Thill<br>Technical Communication – John M. Lannon, Laura J. Gurak<br>The Craft of Scientific Writing – Michael Alley<br>How to Write and Publish a Scientific Paper – Barbara Gastel, Robert A. Day       |         |             |         |     |                           |     |               |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                          |         |             |     |                           |     |               |     |      |      |
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| Module                             | GM2.6                                                                                                                                                                                                                                                                                                                                                                    |         |             |     |                           |     |               |     |      |      |
| Module coordinator                 | Nihel Ziadi                                                                                                                                                                                                                                                                                                                                                              |         |             |     |                           |     |               |     |      |      |
| Course name                        | English                                                                                                                                                                                                                                                                                                                                                                  |         |             |     |                           |     |               |     |      |      |
| Course teacher                     | Nihel Ziadi                                                                                                                                                                                                                                                                                                                                                              |         |             |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                        |         |             |     |                           |     |               |     | 3    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                        |         |             |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                        |         | Nb of hours |     |                           |     |               |     |      |      |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                       | Lecture | Seminar     |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                          | 21      | 14          |     |                           | 7   |               |     |      |      |
| Course Description                 | English Curriculum for ICAI4<br>The First session: A preparation for the TOEIC from TARGET SCORE<br>The second session: Oral presentations                                                                                                                                                                                                                               |         |             |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | To prepare students for the TOEIC exam and improve their oral presentation skills.                                                                                                                                                                                                                                                                                       |         |             |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                      | CS2     | CS3         | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                          |         |             |     |                           |     |               |     | XX   |      |
| Course Structure                   | The course is delivered in-lab using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                                                  |         |             |     |                           |     |               |     |      |      |
| Prerequisite                       | Basic English proficiency.                                                                                                                                                                                                                                                                                                                                               |         |             |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                         |         |             |     |                           |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                                        |         |             |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | The Complete Guide to the TOEIC Test by Bruce Rogers<br>Kaplan's TOEIC Listening and Reading Prep by Kaplan Test Prep<br>Barron's TOEIC by Lin Lougheed<br>Speak Up: An Illustrated Guide to Public Speaking by Douglas M Fraleigh and Joseph S Tuman<br>Presentation Skills 201: How to Take it to the Next Level as a Confident Engaging Presenter by William R Steele |         |             |     |                           |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|---------------|-----|------|------|
| Module                             | GM2.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |               |     |      |      |
| Module coordinator                 | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |               |     |      |      |
| Course name                        | Corporate culture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |
| Course teacher                     | Monia Hichri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |               |     | ECTS |      |
| Year                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     | 1    |      |
| Semester                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nb of hours |         |     |                           |     |               |     |      |      |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 14hrs       | 5hrs    |     |                           |     | 2hrs          |     |      |      |
| Course Description                 | <b>Corporate culture</b><br><b>Chapter I:</b> Why teach the subject Corporate Culture?/ <b>Chapter II:</b> The company and its environment<br><b>Chapter III:</b> The profile of the Entrepreneur/ <b>Chapter IV:</b> Sources of project ideas(Project feasibility study)<br><b>Chapter V:</b> The Business Plan/ Chapter VI: Market study/ <b>Chapter VII:</b> Strategies and marketing plan/<br><b>Chapter VIII:</b> Technical Study/ <b>Chapter IX:</b> Study of profitability / <b>Chapter X:</b> The financial plan and sources of financing for projects / <b>Chapter XI:</b> Choice of legal status |             |         |     |                           |     |               |     |      |      |
| Aims and Outcomes                  | To prepare students to understand corporate culture, entrepreneurship, and project development including feasibility, planning, marketing, finance, and legal aspects.                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |
|                                    | CS1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9  | CS10 |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      | XX   |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |
| Course Structure                   | The course is delivered in-class using lectures including interactive tasks/manipulations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |               |     |      |      |
| Prerequisite                       | Basic knowledge of business concepts and fundamental understanding of economics and management.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |
| Course Requirements                | Teacher presence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |
| Required text                      | Programmed course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |
| Recommended Texts & Other Readings | Corporate Culture and Leadership by Edgar H. Schein<br>Entrepreneurship: Theory, Process, and Practice by Donald F. Kuratko<br>Business Model Generation by Alexander Osterwalder and Yves Pigneur<br>The Lean Startup by Eric Ries                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|-----|---------------------------|-----|-----|---------------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|--|--|--|--|--|--|--|--|--|--|--|
| Module                             | CM 3.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Course name                        | Industrial Processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Course teacher                     | Pr. Arbi MGAIDI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Nb of hours |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture     | Seminar |     |     | Practical Course/Lab work |     |     | Personal work |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 15 hrs      | 6 hrs   |     |     | 21                        |     |     | 6 hrs         |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Course Description                 | Chapter I: Thermodynamic reminders, Chapter II: Kinetic reminders, Chapter III: Classification of Unit Operations, Chapter IV: Oil Refining, Chapter V: The Paper Industry / Paper, Chapter VI:, The leather industry, Chapter VII: Perfume and cosmetic products, Chapter VIII: Phosphoric acion                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Aims and Outcomes                  | <p>The purpose of the course is to teach students the basics of chemical engineering as it relates to process industries. This is done by giving them: a solid grasp of thermodynamics and kinetics, an understanding of unit operations, and a broad look at several key industrial sectors.</p> <p>This course is likely an introduction to industrial processes, which will be useful for students who want to become chemical or process engineers.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |     |                           |     |     |               |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 |  |  |  |  |  |  |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CS3         | CS4     | CS5 | CS6 | CS7                       | CS8 | CS9 | CS10          | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Prerequisite                       | This course requires a solid foundation in science chemistry, physics, and mathematics as well as an introduction to process engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |
| Recommended Texts & Other Readings | "Elementary Principles of Chemical Processes" – Richard M. Felder & Ronald W. Rousseau<br>"Chemical Engineering Design" – Gavin Towler & Ray Sinnott<br>"Phosphoric Acid: Purification, Uses, Technology, and Economics" – Edited by A. Green                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |  |  |  |  |  |  |  |  |  |  |  |

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|---------------|----------------|
| <b>Module</b> | <b>G.M 3.1</b> |
|---------------|----------------|

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Electrochemical Methods of Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Dr. Abdessatar CHERNI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Nb of hours |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 15 hrs      | 6 hrs   |     | 0                         |     | 6 hrs         |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Reminder of the basic concepts developed in IC3, Chapter II: Potentiometric methods. Chapter III: One or two amperometric methods indicator electrodes.Chapter IV: Electrolysis at controlled potential., Chapter V: Constant current electrolysis., Chapter VI: Impulse polarographic methods., Chapter VII: Conductimetry and conductometric titrations, Chapter VIII: Analysis by Anodic and Cathodic Redissolution.                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <p>The purpose of the course is to teach students the basics of chemical engineering as it relates to process industries. This is done by giving them:<br/>a solid grasp of thermodynamics and kinetics, an understanding of unit operations, and a broad look at several key industrial sectors.</p> <p>This course is likely an introduction to industrial processes, which will be useful for students who want to become chemical or process engineers.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |               |     |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8           | CS9 | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     | X                         |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | Basic knowledge of physical chemistry (redox reactions, electrochemical equilibrium)Fundamentals of electrochemistry (concepts covered in IC3 or equivalent)Mastery of units, concentration calculations, and equilibria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Electrochemical Techniques in Analytical Chemistry" – Joseph Wang<br>Principles of Instrumental Analysis – Skoog, Holler & Crouch<br>Quantitative Chemical Analysis – Daniel C. Harris                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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| Module                             | GM 3.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | TP. Electrochemical methods of analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Dr. Abdessatar CHERNI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |                           |     |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nb of hours |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture     | Seminar | Practical Course/Lab work |     |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 15 hrs      | 6 hrs   | 28                        |     |     |     | 6 hrs         |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | <b>Manipulation I:</b> Potentiometer at zero current. Application to the determination of cyanide ions<br><b>Manipulation II:</b> oxidation-reduction and complexes Cr(VI) titration of Fe(II) alone and in the presence of H <sub>3</sub> PO <sub>4</sub> , <b>Handling III:</b> Halide dosages, <b>Manipulation IV:</b> Current potentiometer, <b>Manipulation V:</b> Amperometry at imposed potential, <b>Manipulation VI:</b> Conductimetric titration : acid-base dosage (strong acid, weak and mixtures of strong and weak acids), <b>Manipulation VII:</b> Conductimetric titration: dosage by complexation and by precipitation, <b>Handling VIII:</b> Dosing of a mixture of metal cations using pulse polarography, <b>Manipulation IX:</b> Anodic redissolution |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <p>The purpose of the course is to teach students the basics of chemical engineering as it relates to process industries. This is done by giving them:<br/>a solid grasp of thermodynamics and kinetics, an understanding of unit operations, and a broad look at several key industrial sectors.</p> <p>This course is likely an introduction to industrial processes, which will be useful for students who want to become chemical or process engineers.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table>                               |             |         |                           |     |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CS3         | CS4     | CS5                       | CS6 | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                           | X   |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | Basic knowledge of physical chemistry (redox reactions, electrochemical equilibrium)Fundamentals of electrochemistry (concepts covered in IC3 or equivalent)Mastery of units, concentration calculations, and equilibria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Electrochemical Techniques in Analytical Chemistry" – Joseph Wang<br>Principles of Instrumental Analysis – Skoog, Holler & Crouch<br>Quantitative Chemical Analysis – Daniel C. Harris                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |                           |     |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

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| <b>Module</b> | <b>G.M 3.2</b> |
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|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Water Analysis and Treatment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Pr. Chiraz HANNACHI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15 hrs      | 6 hrs   |     | 0                         |     |     | 6 hrs         |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Part one: Water analysis<br>Chapter I: General information and reminders<br>Chapter II: Chemistry of natural waters<br>Chapter III: Specific titles to water treatment<br>Chapter IV: Calco-carbonic balances<br>PART TWO: WATER TREATMENT<br>Chapter I: Treatment sectors<br>Chapter II: Application of ion exchange resins<br>Chapter III: Softening by chemical precipitation<br>Chapter IV: Disinfection<br>Chapter V: Elimination of Iron and Manganese<br>Chapter VI: Membrane processes.                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | This course provides students with the scientific and technical basics needed to analyze and treat water, covering the characteristics of natural waters and the main methods used to make water safe for drinking, industrial use, or meeting environmental standards. <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     | X                         |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | Knowledge of general chemistry (acid-base equilibria, solubility, redox)<br>Basics of analytical chemistry (titration, spectrophotometry...)<br>Notions in environmental chemistry or water sciences                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Water and Wastewater Technology" – Mark J. Hammer & Mark J. Hammer Jr.<br>Water Treatment: Principles and Design" – MWH, John C. Crittenden et al.<br>Standard Methods for the Examination of Water and Wastewater" – APHA, AWWA, WEF                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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| Module                             | G.M 3.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Enantiomer Separation Methods                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               | ECTS |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Nb of hours |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15 hrs      | 6 hrs   |     | 0                         |     |     | 6 hrs         |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Introduction. Why the separation of enantiomers?<br>Chapter II: Stereochemical concept<br>Chapter III: Splitting of a racemic mixture                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | The aim of this course is to provide students with a comprehensive understanding of the principles and techniques used for the separation of enantiomers from racemic mixtures. Through theoretical and practical approaches, the course explores the stereochemical foundations of chirality and presents the main methods of resolution, including crystallization, formation and separation of diastereoisomers, and kinetic resolution (both chemical and enzymatic). |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table>                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     | X                         |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | To successfully follow this course, students should have acquired basic knowledge in the following areas: General Organic Chemistry, Stereochemical Organic Chemistry<br>Basic Analytical Chemistry                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Jean Jacques, André Collet, Samuel Wilen – <i>Enantiomers, Racemates, and Resolutions</i><br>Eliel & Wilen – <i>Stereochemistry of Organic Compounds</i><br>Nakai, Ohkura, & Yamada – <i>Optical Resolution Processes for Chiral Compounds</i><br>Revue : <i>Tetrahedron: Asymmetry</i> (publie régulièrement sur les résolutions énantiomériques)<br><br>Revue : <i>Chirality</i>                                                                                        |             |         |     |                           |     |     |               |      |      |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Chemistry of Essential Oils (EO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Ikram Ben Chehida                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 15 hrs      | 6 hrs   |     | 0                         |     |     | 6 hrs         |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Introduction to aromatic and medicinal plants (PAM)<br>Chapter II: EO extraction processes<br>Chapter III: Analysis of the chemical composition of EOs<br>Chapter IV: Varied applications of HE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | The course aims to provide students with fundamental and applied knowledge of the chemistry of essential oils (EOs), from their botanical sources to extraction, analysis, and practical applications. The focus is on understanding the biosynthetic origin, chemical diversity, analytical techniques, and uses of essential oils in various sectors such as pharmaceuticals, cosmetics, food, and aromatherapy. <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     | X                         |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | General Organic Chemistry,Structure and reactivity of organic compounds., Functional groups, hydrocarbons, alcohols, ketones, esters, etc. Basic Natural Products Chemistry,Introduction to secondary metabolites (terpenes, alkaloids, phenolics).Analytical Chemistry, Basic knowledge of chromatographic (GC, HPLC) and spectroscopic methods (MS, IR, UV), Biochemistry (recommended)Enzymatic pathways involved in terpene biosynthesis.                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Baser & Buchbauer – Handbook of Essential Oils: Science, Technology, and Applications<br>E. Guenther – The Essential Oils, Volumes I–VI<br>Lis-Balchin – Aromatherapy Science: A Guide for Healthcare Professionals<br>Tisserand & Young – Essential Oil Safety: A Guide for Health Care Professionals                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|---------------|-----|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Agri-food biotechnology : The agri-food sector (sectors), bioresources and biotechnologies (Tools).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Fatma Hmaied                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |               |     |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Nb of hours |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15 hrs      | 6 hrs   |     | 0                         |     | 6 hrs         |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Food composition and safety and properties required.<br>Chapter II: Contamination<br>Chapter III: Microbiological analyzes of foods and basis of standards<br>Chapter IV: The different tools and means available for controlling food quality and safety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <p>The aim of this course is to equip students with an integrated understanding of the agri-food sector through the lens of biotechnology. It focuses on the composition, safety, and quality of food products, emphasizing contamination risks and methods for their detection and control. The course also introduces the main biotechnological tools and industrial microbiology processes, especially fermentation, highlighting their role in producing and controlling fermented foods. Through theoretical knowledge and practical examples, students will acquire skills to apply quality management systems such as ISO 22000 and HACCP, and to evaluate the microbial and sensory properties of food products.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |               |     |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8           | CS9 | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     | X                         |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | <b>Basic Microbiology</b> : Understanding of microbial types, growth, and roles in food systems., <b>Food Chemistry</b> :Composition of food macronutrients and micronutrients., <b>Biotechnology Principle</b> :General knowledge of biotechnology tools and applications., <b>Basic Analytical Techniques</b> : Familiarity with laboratory analysis methods relevant to food science.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | <b>Garrett, E. H. – Food Safety Management: A Practical Guide for the Food Industry (2013)</b> Practical insights on ISO 22000, HACCP, and GHP applications. <b>Ray, B., &amp; Bhunia, A. – Fundamental Food Microbiology, 5th Edition (2013)</b> Detailed focus on foodborne pathogens and microbial analysis. <b>Perry, J. L., &amp; Stadelman, W. J. – Food Safety: Theory and Practice (2011)</b> Includes chapters on HACCP, GHP, and food quality control.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

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| Module                             | G.M 3.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Validation of analysis methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Pr. Hager MAGHRAOUI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |     |                           |     |     |               | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Nb of hours |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lecture     | Seminar |     |     | Practical Course/Lab work |     |     | Personal work |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15 hrs      | 6 hrs   |     |     | 0                         |     |     | 6 hrs         |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: verification tests of experimental data<br>Chapter II: evaluation of the reliability of an analysis method<br>Chapter III: evaluation of the accuracy of an analysis method<br>Chapter IV: evaluation of the performance of a calibration curve<br>Chapter V: evaluation of the specificity of an analysis method<br>Chapter VI: evaluation of the robustness of an analysis method                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | The aim of this course is to provide students with a thorough understanding of the principles and practices involved in validating analytical methods used in scientific research and quality control. The course covers the evaluation of experimental data reliability, accuracy, specificity, robustness, and calibration performance. By mastering these concepts, students will be equipped to design, assess, and validate analytical methods to ensure their suitability for intended applications, particularly in pharmaceutical, chemical, and food industries.<br><table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |     |                           |     |     |               |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CS3         | CS4     | CS5 | CS6 | CS7                       | CS8 | CS9 | CS10          | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     | X   |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | Basic Analytical Chemistry, Understanding of analytical techniques (e.g., spectroscopy, chromatography), Concepts of precision, accuracy, sensitivity, and specificity. Statistics for Analytical Chemistry, Basic statistics including data distribution, variance, hypothesis testing, Calibration and Quantitative Analysis, Construction and use of calibration curves. Error analysis and measurement uncertainty.                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | Harris, D. C. – <i>Quantitative Chemical Analysis</i> , 9th Edition (2015)<br>Skoog, D. A., Holler, F. J., & Crouch, S. R. – <i>Principles of Instrumental Analysis</i> , 7th Edition (2017)<br>ICH Q2(R1) – <i>Validation of Analytical Procedures: Text and Methodology</i> (2005)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|---------------|-----|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Chemical Engineering                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | *****                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |     |                           |     |               |     |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Nb of hours |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15 hrs      | 6 hrs   |     | 0                         |     | 6 hrs         |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Distillation<br>Chapter II: Liquid-liquid extraction<br>Chapter III: Crystallization<br>Chapter IV: Filtration<br>Chapter V: Chemical reactors<br>Chapter VI: Fluidization – Drying                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <p>The aim of this course is to provide students with a fundamental understanding of core unit operations and processes in chemical engineering. Students will learn the principles and practical applications of separation techniques such as distillation, liquid-liquid extraction, crystallization, and filtration. The course also covers essential reaction engineering concepts, fluidization, and drying processes. By the end of the course, students should be able to design, analyze, and optimize these operations in industrial and laboratory settings.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |               |     |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8           | CS9 | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     | X                         |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | General Chemistry and Physical Chemistry, Thermodynamics, phase equilibria, reaction kinetics.,Mathematics,Calculus, differential equations, linear algebra., Fluid Mechanics and Heat Transfer (Basic Concepts),Understanding of fluid flow, heat and mass transfer, Basic Chemical Engineering Principles, Introduction to material and energy balances.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | McCabe, W. L., Smith, J. C., & Harriott, P. – <i>Unit Operations of Chemical Engineering</i> , 7th Edition .<br>Fogler, H. S. – <i>Elements of Chemical Reaction Engineering</i> , 5th Edition   Geankoplis, C. J. – <i>Transport Processes and Separation Process Principles</i> , 4th Edition (2003). Wankat, P. C. – <i>Separation Process Engineering</i> , 2nd Edition (2007)                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |               |     |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Olfa CHAARI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15 hrs      | 6 hrs   |     | 0                         |     |     | 6 hrs         |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | <p><b>The first part: Reading and Writing:</b> The first part focuses on reading and writing. Students are required to read guidelines on how to write good letters of applications, letters of internships, CVs... Thereafter, they are asked to write their own CV and their own letter of application responding to a job advertisement.</p> <p><b>The second part: Listening and Speaking (Oral presentations)</b><br/>The second session is devoted to oral presentations. Students are required to prepare a topic of their choice and present it in class. The aim of this session is to improve their speaking skills. Students learn how to take notes during a presentation, how to evaluate and ask questions.</p>                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | <p>The aim of this course is to provide students with a fundamental understanding of core unit operations and processes in chemical engineering. Students will learn the principles and practical applications of separation techniques such as distillation, liquid-liquid extraction, crystallization, and filtration. The course also covers essential reaction engineering concepts, fluidization, and drying processes. By the end of the course, students should be able to design, analyze, and optimize these operations in industrial and laboratory settings.</p> <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table> |             |         |     |                           |     |     |               |      |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     | X                         |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | Basic English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                              |             |         |     |                           |     |               |     |     |      |      |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|---------------|-----|-----|------|------|
| Module                             | G.M 3.4                                                                                                                                                                                                      |             |         |     |                           |     |               |     |     |      |      |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                             |             |         |     |                           |     |               |     |     |      |      |
| Course name                        | Hygiene and safety                                                                                                                                                                                           |             |         |     |                           |     |               |     |     |      |      |
| Course teacher                     | Sahar Raissi                                                                                                                                                                                                 |             |         |     |                           |     |               |     |     | ECTS |      |
| Year                               | 5                                                                                                                                                                                                            |             |         |     |                           |     |               |     |     |      |      |
| Semester                           | S1                                                                                                                                                                                                           |             |         |     |                           |     |               |     |     |      |      |
| Workload                           | Total nb of hours                                                                                                                                                                                            | Nb of hours |         |     |                           |     |               |     |     |      |      |
|                                    | 21                                                                                                                                                                                                           | Lecture     | Seminar |     | Practical Course/Lab work |     | Personal work |     |     |      |      |
|                                    |                                                                                                                                                                                                              | 15 hrs      | 6 hrs   |     | 0                         |     | 6 hrs         |     |     |      |      |
| Course Description                 | Chapter 1: Introduction to QHSE, Chapter 2: Chemical Risk, Chapter 3: Fire Risk, Chapter 4: Radiation Risk<br>Chapter 5: Electrical Risk                                                                     |             |         |     |                           |     |               |     |     |      |      |
| Aims and Outcomes                  | Provide engineering students with the fundamental principles of hygiene, health, safety, and environmental management (QHSE) in industrial contexts.                                                         |             |         |     |                           |     |               |     |     |      |      |
|                                    | Develop awareness of various professional risks, particularly chemical, electrical, radiological, and fire-related risks.                                                                                    |             |         |     |                           |     |               |     |     |      |      |
|                                    | Equip students with preventive and protective measures aligned with international safety standards.<br>Foster a safety culture essential to responsible engineering practice and industrial decision-making. |             |         |     |                           |     |               |     |     |      |      |
|                                    | CS1                                                                                                                                                                                                          | CS2         | CS3     | CS4 | CS5                       | CS6 | CS7           | CS8 | CS9 | CS10 | CS11 |
|                                    | X                                                                                                                                                                                                            |             |         |     |                           | X   |               |     |     |      |      |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                              |             |         |     |                           |     |               |     |     |      |      |
| Prerequisite                       | A solid scientific foundation and skills in mathematics, physics, and chemistry are often preferred. Analytical, rigorous, and communication skills are also important.                                      |             |         |     |                           |     |               |     |     |      |      |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                       |             |         |     |                           |     |               |     |     |      |      |
| Required text                      | Conference slides and related material                                                                                                                                                                       |             |         |     |                           |     |               |     |     |      |      |
| Recommended Texts & Other Readings | Albert DAVID, Éditions Prévention<br>ISBN-13 : 978-2953922417                                                                                                                                                |             |         |     |                           |     |               |     |     |      |      |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|-----|---------------------------|-----|-----|---------------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Quality Control Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Pr. Hager MGHRAOUI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |     |                           |     |     |               | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Nb of hours |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture     | Seminar |     |     | Practical Course/Lab work |     |     | Personal work |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 15 hrs      | 6 hrs   |     |     | 0                         |     |     | 6 hrs         |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Concepts and terminology<br>The ISO 17000 standard : assessment of conformity-vocabulary and general principle<br>The ISO 9000 standard: quality management system-principles essentials and vocabulary<br>Chapter II: management requirements ISO / IEC 17025 (2017)                                                                                                                                                                                                                       |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Aims and Outcomes                  | The aim of learning ISO/IEC 17025:2017 is to understand and implement the international standard that specifies the general requirements for the competence, impartiality, and consistent operation of laboratories.                                                                                                                                                                                                                                                                                   |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | <table><tr><td>CS1</td><td>CS2</td><td>CS3</td><td>CS4</td><td>CS5</td><td>CS6</td><td>CS7</td><td>CS8</td><td>CS9</td><td>CS10</td><td>CS11</td></tr><tr><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr></table>                                                                                                                                                                                                                           |             |         |     |     |                           |     |     |               |      |  | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | X |  |  |  |  | X |  |  |  |  |  |
| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CS3         | CS4     | CS5 | CS6 | CS7                       | CS8 | CS9 | CS10          | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     | X   |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Prerequisite                       | should have a basic understanding of metrology, including concepts like measurement, traceability, uncertainty, and calibration, along with familiarity with measurement and testing equipment. Knowledge of quality management systems, especially ISO 9001, is helpful for understanding quality processes and documentation. Practical experience in a testing or calibration laboratory is a strong asset, as is the ability to interpret test results and analyze non-conformities                |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Recommended Texts & Other Readings | ISO/IEC 17025:2017 – General requirements for the competence of testing and calibration laboratories. International Organization for Standardization, Geneva, 2017.<br>ILAC (International Laboratory Accreditation Cooperation). Guidance documents on the application of ISO/IEC 17025. <a href="https://ilac.org/">https://ilac.org/</a><br>BIPM (International Bureau of Weights and Measures). Resources on metrology and traceability. <a href="https://www.bipm.org/">https://www.bipm.org/</a> |             |         |     |     |                           |     |     |               |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|-----|---------------------------|-----|-----|---------------|------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|---|--|--|--|--|---|--|--|--|--|--|
| Module                             | G.M 3.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Module coordinator                 | Pr. Hedi M'rabet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course name                        | Quality Control Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course teacher                     | Pr. Hager MGHRAOUI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      | ECTS |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Year                               | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Semester                           | S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Workload                           | Total nb of hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Nb of hours |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    | 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Lecture     | Seminar |     | Practical Course/Lab work |     |     | Personal work |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15 hrs      | 6 hrs   |     | 0                         |     |     | 6 hrs         |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Description                 | Chapter I: Concepts and terminology<br>The ISO 17000 standard : assessment of conformity-vocabulary and general principle<br>The ISO 9000 standard: quality management system-principles essentials and vocabulary<br>Chapter II: management requirements ISO / IEC 17025 (2017)                                                                                                                                                                                                                         |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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| CS1                                | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CS3         | CS4     | CS5 | CS6                       | CS7 | CS8 | CS9           | CS10 | CS11 |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| X                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     | X                         |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Course Structure                   | This is an in-person course featuring engaging, hands-on tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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| Course Requirements                | Internet connection, video projection;                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
| Required text                      | Conference slides and related material                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |     |                           |     |     |               |      |      |  |     |     |     |     |     |     |     |     |     |      |      |   |  |  |  |  |   |  |  |  |  |  |
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## Final Year Project (FYP)

**Program:** Analytical Chemistry and Instrumentation

**Semester:** 6th Semester (S6)

**Credits:** 15 ECTS

## 1- Objectives

The Final Year Project (FYP) is a capstone component of the program, aiming to:

Apply theoretical and practical knowledge acquired throughout the academic curriculum.

Address a real-world problem in a professional or academic setting.

Develop critical thinking, scientific communication, and project management skills.

Facilitate students' integration into the professional environment and improve employability.

## 2- Content and Structure

The project is typically conducted within a company, research lab, or academic institution, and includes:

Orientation and integration within the host organization.

Problem definition and project planning.

Literature review and state-of-the-art analysis.

Experimental, theoretical, or technical work.

Scientific report writing.

Oral defense before an academic jury.

## Skills Developed

**Technical:** Use of analytical instruments, experimental design, data analysis.

**Transversal:** Autonomy, teamwork, scientific writing, communication, time management.

**Professional:** Adaptation to workplace environments, ethics, safety protocols.

## Supervision

Each student is supervised by:

An **academic supervisor** from the Faculty

A **professional supervisor** from the host institution or company.

## Evaluation Criteria

The final grade is based on the following components:

**Company supervisor evaluation (60%),** based on:

Work capacity, autonomy, responsibility, punctuality.

Teamwork, compliance with internal regulations.

Technical and analytical skills, quality of work, maturity.

**Written report evaluation by academic jury (20%)**

**Oral defense evaluation by academic jury (20%)**



## Indicative Timeline

**January – February:** Search for internship, signature of internship agreement.

**March – May:** Internship period and project execution.

**June:** Report writing and oral defense.

## Deliverables

Signed internship agreement.

Evaluation form completed by the company supervisor.  
Final written report (both digital and printed versions).  
Oral presentation before the jury.