

## 1. Course Description

| COURSE DESCRIPTION FORM                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Code and Title                                                         | CHE474 MASS TRANSFER II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Semester                                                               | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Catalog Description (Content) of the Course                                   | Evaporation, extraction and leaching, drying, cooling towers filtration, crystallization, adsorption and ion exchange, grinding.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Main Textbook                                                                 | Geancoplin, C.J., Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Edit., Prentice Hall Book Co., London, 2003                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Supporting Textbooks                                                          | McCabe, W.J., Smith, J.C., Harriot, H., Unit Operations of Chem. Eng., 3rd Edit., McGraw Hill Book Co., London, 1976. • Treybal, R.E., Mass Transfer Operations, McGraw-Hill Book Co., Singapore, 1981.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Credit (ECTS)                                                          | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Prerequisites of the Course (Compulsory attendance should be indicated here.) | There is no prerequisite or co-requisite for this course.<br>70% Attendance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Type of the Course                                                            | Compulsory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Instruction Language of the Course                                            | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Object and Target of the Course                                               | Learning the design and study of the extraction, evaporation, cooling towers, filtration, drying, crystallization, adsorption, ion exchange and grinding in detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Learning Outcomes of the Course                                               | 1. Learning the application of mass transfer to separation processes.<br>2. Especially, design calculations of unit operations such as extraction, leaching, evaporation, drying, and filtration, cooling towers, crystallization, grinding, adsorption and ion exchange in detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Mode of Delivery                                                              | The mode of delivery of this course is face to face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Weekly Schedule of the Course                                                 | <p><b>1. Week</b> Introduction. General study of separation processes.</p> <p><b>2. Week</b> Extraction and leaching, analysis of immiscible and partially miscible liquid systems, co- or counter-current and single or multiple effect systems.</p> <p><b>3. Week</b> Extraction and leaching, analysis of immiscible and partially miscible liquid systems, co- or counter-current and single or multiple effect systems.</p> <p><b>4. Week</b> Extraction and leaching, analysis of immiscible and partially miscible liquid systems, co- or counter-current and single or multiple effect systems.</p> <p><b>5. Week</b> Extraction and leaching, analysis of immiscible and partially miscible liquid systems, co- or counter-current and single or multiple effect systems.</p> <p><b>6.</b> Evaporation, energy equations for single and</p> |

|                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                                  |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
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|                                                                                                                                                     | <p><b>Week</b> multiple stage systems, forward, backward and parallel feed, effects of boiling point rising.</p> <p><b>7. Week</b> Evaporation, energy equations for single and multiple stage systems, forward, backward and parallel feed, effects of boiling point rising.</p> <p><b>8. Week</b> Evaporation, energy equations for single and multiple stage systems, forward, backward and parallel feed, effects of boiling point rising.</p> <p><b>9. Week</b> Filtration, basic filtration equation and mathematical analysis.</p> <p><b>10. Week</b> Filtration, basic filtration equation and mathematical analysis.</p> <p><b>11. Week</b> Drying, mathematical analysis for different rate curves.</p> <p><b>12. Week</b> Drying, mathematical analysis for different rate curves.</p> <p><b>13. Week</b> Adsorption, adsorption types and isotherms, efficient parameters.</p> <p><b>14. Week</b> Adsorption, adsorption types and isotherms, efficient parameters.</p> |                         |                                  |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
| <p><b>Educative Activities</b><br/><i>(Credit will be determined based on the time given for these activities. Should be filled carefully.)</i></p> | <p>Theoretical Study Hours of Course Per Week</p> <p>Searching in Internet and Library</p> <p>Preparing Reports</p> <p>Mid-Term and Studying for Mid-Term</p> <p>Final and Studying for Final</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                                  |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
| <p><b>Assessment Criteria</b></p>                                                                                                                   | <table><tr><td></td><td></td><td><b>Quantity</b></td><td><b>Total Contribution (%)</b></td><td></td></tr><tr><td></td><td>Midterm</td><td>2</td><td>40</td><td></td></tr><tr><td></td><td>Homework</td><td>1</td><td>20</td><td></td></tr><tr><td></td><td>Assignment</td><td>0</td><td>0</td><td></td></tr><tr><td></td><td>Projects</td><td>0</td><td>0</td><td></td></tr><tr><td></td><td>Practice</td><td>0</td><td>0</td><td></td></tr><tr><td></td><td>Quiz</td><td>0</td><td>0</td><td></td></tr><tr><td></td><td>Contribution of In-term Studies to Overall Grade</td><td></td><td>60</td><td></td></tr><tr><td></td><td>Contribution of Final Examination to Overall Grade</td><td></td><td>40</td><td></td></tr><tr><td></td><td>Attendance</td><td></td><td>0</td><td></td></tr></table>                                                                                                                                                                                 |                         |                                  | <b>Quantity</b>                   | <b>Total Contribution (%)</b>    |                                   |  | Midterm                                    | 2  | 40 |    |  | Homework                            | 1 | 20 |   |  | Assignment | 0 | 0 |   |  | Projects                          | 0 | 0  |    |  | Practice               | 0 | 0 |   |  | Quiz | 0 | 0 |  |  | Contribution of In-term Studies to Overall Grade |  | 60 |  |  | Contribution of Final Examination to Overall Grade |  | 40 |  |  | Attendance |  | 0 |  |
|                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Quantity</b>         | <b>Total Contribution (%)</b>    |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Midterm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2                       | 40                               |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Homework                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1                       | 20                               |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Assignment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                       | 0                                |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0                       | 0                                |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Practice                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0                       | 0                                |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Quiz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0                       | 0                                |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Contribution of In-term Studies to Overall Grade                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         | 60                               |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Contribution of Final Examination to Overall Grade                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         | 40                               |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Attendance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         | 0                                |                                   |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
| <p><b>Workload of the Course</b></p>                                                                                                                | <table><tr><td></td><td><b>Activity</b></td><td><b>Total Week Count</b></td><td><b>Weekly Duration (in hour)</b></td><td><b>Total Workload in Semester</b></td></tr><tr><td></td><td>Theoretical Study Hours of Course Per Week</td><td>14</td><td>3</td><td>42</td></tr><tr><td></td><td>Practicing Hours of Course Per Week</td><td>0</td><td>0</td><td>0</td></tr><tr><td></td><td>Reading</td><td>0</td><td>0</td><td>0</td></tr><tr><td></td><td>Searching in Internet and Library</td><td>1</td><td>25</td><td>25</td></tr><tr><td></td><td>Designing and Applying</td><td>0</td><td>0</td><td>0</td></tr></table>                                                                                                                                                                                                                                                                                                                                                            |                         | <b>Activity</b>                  | <b>Total Week Count</b>           | <b>Weekly Duration (in hour)</b> | <b>Total Workload in Semester</b> |  | Theoretical Study Hours of Course Per Week | 14 | 3  | 42 |  | Practicing Hours of Course Per Week | 0 | 0  | 0 |  | Reading    | 0 | 0 | 0 |  | Searching in Internet and Library | 1 | 25 | 25 |  | Designing and Applying | 0 | 0 | 0 |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | <b>Activity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Total Week Count</b> | <b>Weekly Duration (in hour)</b> | <b>Total Workload in Semester</b> |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Theoretical Study Hours of Course Per Week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14                      | 3                                | 42                                |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Practicing Hours of Course Per Week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0                       | 0                                | 0                                 |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Reading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                       | 0                                | 0                                 |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Searching in Internet and Library                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                       | 25                               | 25                                |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |
|                                                                                                                                                     | Designing and Applying                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0                       | 0                                | 0                                 |                                  |                                   |  |                                            |    |    |    |  |                                     |   |    |   |  |            |   |   |   |  |                                   |   |    |    |  |                        |   |   |   |  |      |   |   |  |  |                                                  |  |    |  |  |                                                    |  |    |  |  |            |  |   |  |

|  |                                    |   |    |      |
|--|------------------------------------|---|----|------|
|  | Materials                          |   |    |      |
|  | Preparing Reports                  | 1 | 25 | 25   |
|  | Preparing Presentation             | 0 | 0  | 0    |
|  | Presentation                       | 0 | 0  | 0    |
|  | Mid-Term and Studying for Mid-Term | 2 | 10 | 20   |
|  | Final and Studying for Final       | 1 | 10 | 10   |
|  | Other                              | 0 | 0  | 0    |
|  | Total work load                    |   |    | 122  |
|  | Total work load/25                 |   |    | 4,88 |
|  | ECTS of the course                 |   |    | 5    |

|                                  |    |                                                                                                                                                                                                                       |   |   |   |   |   |
|----------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Course's Contribution To Program | No | PROGRAM LEARNING OUTCOMES                                                                                                                                                                                             | 1 | 2 | 3 | 4 | 5 |
|                                  | 1  | Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems. |   |   |   | x |   |
|                                  | 2  | Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.                                                            |   |   |   | x |   |
|                                  | 3  | Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.      |   |   | x |   |   |
|                                  | 4  | Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.                                                               |   |   | x |   |   |
|                                  | 5  | Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.                                                                                         |   |   | x |   |   |
|                                  | 6  | Ability to work efficiently in intra-disciplinary teams.                                                                                                                                                              |   |   |   |   | x |
|                                  | 7  | Ability to work efficiently in multi-disciplinary teams;                                                                                                                                                              |   |   | x |   |   |
|                                  | 8  | Ability to work individually.                                                                                                                                                                                         |   |   | x |   |   |
|                                  | 9  | Ability to communicate effectively in Turkish/English.                                                                                                                                                                |   |   | x |   |   |

|                                             |    |                                                                                                                    |                                                                                                                                                                         |  |   |   |  |   |
|---------------------------------------------|----|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|---|--|---|
|                                             |    |                                                                                                                    | both orally and in writing; Ability to write effective reports and comprehend written reports, make effective presentations,                                            |  |   |   |  |   |
|                                             | 10 |                                                                                                                    | Prepare design and production reports, give and receive clear and intelligible instructions.                                                                            |  | x |   |  |   |
|                                             | 11 |                                                                                                                    | Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself. |  |   | x |  |   |
|                                             | 12 |                                                                                                                    | Awareness of professional and ethical responsibility.                                                                                                                   |  |   |   |  | x |
|                                             | 13 |                                                                                                                    | Information about business life practices such as project management, risk management, and change management.                                                           |  |   | x |  |   |
|                                             | 14 |                                                                                                                    | Information about awareness of entrepreneurship, innovation, and sustainable development.                                                                               |  |   | x |  |   |
|                                             | 15 |                                                                                                                    | Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety.                                    |  |   | x |  |   |
|                                             | 16 |                                                                                                                    | Knowledge about awareness of the legal consequences of engineering solutions.                                                                                           |  |   | x |  |   |
|                                             | 17 |                                                                                                                    | Knowledge on standards used in engineering practice.                                                                                                                    |  |   | x |  |   |
| Name of Lecturer(s) and Contact Information |    | 1. Prof. Dr. Atilla MURATHAN<br>E-posta adresi murathan@gazi.edu.tr<br>2. Prof. Dr.Göksel ÖZKAN gozkan@gazi.edu.tr |                                                                                                                                                                         |  |   |   |  |   |