**COURSE SPECIFICATION**

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| This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification. |

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| College of Engineering/ University of Baghdad | 1. Teaching Institution |
| Chemical Engineering | 2. University Department/Centre |
| Unit Operation / CE441 | 3. Course title/code |
| Chemical Engineering Program | 4. Programme(s) to which it contributes |
| Annual System ; There is only one  mode of delivery, which is a “Day  Program”. The students are full time students, and on campus. They attend full day program in face-to-face mode. The academic year is composed of 30-week regular subjects. | 5. Modes of Attendance offered |
| 1st & 2nd / Academic Year 2017 – 2018 | 6. Semester/Year |
| 120 hrs. / 4 hrs. per week | 7. Number of hours tuition (total) |
| 01-10-2017 | 8. Date of production/revision of this specification |
| 9. Aims of the Course | |
| The aims of the course are:   1. To develop an understanding of the transport processes of momentum, heat and mass. 2. To present the basic transport equations and to apply these equations to practical unit operations and separation process. 3. To build the capacity in the design of equipment for physical transformation. 4. To develop knowledge in modern separation processes and sustainable energy. | |

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| 10· Learning Outcomes, Teaching ,Learning and Assessment Method |
| By the end of this course, the student should be able to:   1. Know the importance of unit operation in the design of most of the chemical engineering units. 2. Be familiar with the momentum, heat and mass transport equations and able to use the relevant equations in solving the problems 3. Recognize the analogy between momentum, heat and mass transport. 4. Understand the boundary layer theory. 5. Understand fluid-particle systems and equipment. 6. Understand fluid flow through packed and fluidized beds. 7. Know various chemical engineering separation processes. 8. Select appropriate separation technique for intended problem. 9. Identify separations equipment of various types and their components. 10. Understand the mechanism of the separation by membrane processes and the properties of membrane units. 11. Evaluate competing separation technologies on factors such as simplicity, reliability, and cost. 12. Be able to apply modern knowledge and to apply mathematics, science, engineering and technology to unit operation problems and applications. 13. Work in groups and function on multi-disciplinary teams. 14. Identify, formulate and solve unit operation problems. 15. Understand professional, social and ethical responsibilities. 16. Communicate effectively.   Use the techniques, skills, and modern engineering tools necessary for engineering practice in unit operation applications |
| Teaching and Learning Methods |
| 1. Lectures 2. Tutorials 3. Homework and assignments 4. Tests and Exams 5. In-Class questions and discussions 6. Connection between theory and application 7. Seminars 8. In- and Out-Class oral conservations 9. Reports, presentations, and posters |
| Assessment methods |
| 1. Examinations, Tests, and Quizzes. 2. Extracurricular activities and homework. 3. Student engagement during lectures. |

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| 11. Course Structure | | | | | |
| Assessment Method  (Article 12) | Teaching Method  (Article 11) | Unit Module/Topic | Learning Outcomes  (Article 10) | Hours | Week |
| 3 | 1 | Introduction to unit operation | a, l, m, n, o, p, q | 3  2 theo.  1 tut. | 1 |
| 1-3 | 1-6 | Momentum, Heat, Mass Transport | a, b, m, n, o, p, q | 3  2 theo.  1 tut. | 2 |
| 1-3 | 1-9 | Reynolds Analogy | b, c, m, n, o, p, q | 3  2 theo.  1 tut. | 3 |
| 1-3 | 1-9 | Boundary Layer Concepts | b, c, d, m, n, o, p, q | 3  2 theo.  1 tut.. | 4 |
| 1-3 | 1-9 | Laminar and Turbulent Boundary Layer | b, c, d, m, n, o, p, q | 3  2 theo.  1 tut. | 5 |
| 1-3 | 1-9 | Motion of Particles in a Fluid | b, e, m, n, o, p, q | 3  2 theo.  1 tut. | 6 |
| 1-3 | 1-9 | Flow of Fluids through Granular Beds and Packed Columns | e, f, m, n, o, p, q | 3  2 theo.  1 tut. | 7 |
| 1-3 | 1-9 | Modified Friction Factor in Packed beds | e, m, n, o, p, q | 3  2 theo.  1 tut. | 8 |
| 1-3 | 1-9 | Sedimentation Principles | e, f, g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 9 |
| 1-3 | 1-9 | Design of Thickener | e, f, g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 10 |
| 1-3 | 1-9 | Fluidization Principles | e, f, k, m, n, o, p, q | 3  2 theo.  1 tut. | 11 |
| 1-3 | 1-9 | Minimum Fluidizing and Terminal Falling Velocity | e, f, k, m, n, o, p, q | 3  2 theo.  1 tut. | 12 |
| 1-3 | 1-9 | Liquid-Solid Fluidization | e, f, k, m, n, o, p, q | 3  2 theo.  1 tut. | 13 |
| 1-3 | 1-9 | Liquid Filtration Principles | e, f, g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 14 |
| 1-3 | 1-9 | Modes of Filtration | e, f, g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 15 |
| 1-3 | 1-9 | Types of Filters | e, f, g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 16 |
| 1-3 | 1-9 | Centrifugal Separation Principles | g, h, i, k, m, n, o, p, q | 3  2 theo.  1 tut. | 17 |
| 1-3 | 1-9 | Centrifugal Equipment | g, h, I, m, n, o, p, q | 3  2 theo.  1 tut. | 18 |
| 1-3 | 1-9 | Membrane Separation Processes | J, k, m, n, o, p, q | 3  2 theo.  1 tut. | 19 |
| 1-3 | 1-9 | Micro/Ultra Filtration | J, k, m, n, o, p, q | 3  2 theo.  1 tut. | 20 |
| 1-3 | 1-9 | Reverse Osmosis | J, k, m, n, o, p, q | 3  2 theo.  1 tut. | 21 |
| 1-3 | 1-9 | Adsorption Principles | k, m, n, o, p, q | 3  2 theo.  1 tut. | 22 |
| 1-3 | 1-9 | Adsorption from Liquid | k, m, n, o, p, q | 3  2 theo.  1 tut. | 23 |
| 1-3 | 1-9 | Adsorption Equipment | k, m, n, o, p, q | 3  2 theo.  1 tut. | 24 |
| 1-3 | 1-9 | Ion Exchange Principles | k, m, n, o, p, q | 3  2 theo.  1 tut. | 25 |
| 1-3 | 1-9 | Ion Exchange Equipment | k, m, n, o, p, q | 3  2 theo.  1 tut. | 26 |
| 1-3 | 1-9 | Chromatographic Separation | k, m, n, o, p, q | 3  2 theo.  1 tut. | 27 |
| 1-3 | 1-9 | Types of Chromatography | k, m, n, o, p, q | 3  2 theo.  1 tut. | 28 |
| 1-3 | 1-9 | Sustainability | k, m, n, o, p, q | 3  2 theo.  1 tut. | 29 |
| 1-3 | 1-9 | Sustainable Energy | k, m, n, o, p, q | 3  2 theo.  1 tut. | 30 |

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| 12. Infrastructure | |
| **Text Books:**  1. Chemical Engineering Vol 1, J. M. Coulson and J. F. Richardson, Fifth Edition, Butterworth-Heinmann, 1998.  2. Chemical Engineering Vol 2, J. M. Coulson and J. F. Richardson, Fifth Edition, Butterworth-Heinmann, 2002.  **References:**  1. Unit Operations of Chemical Engineering, W. MacCabe, J. Smith, and P. Harriot, 7th Edition, McGraw Hill, 2002.  2. Principles of Unit Operation, A. S. Foust, L. A. Wenzel, C. W. Clump, L. Maus, L. B. Andersen, 2nd Edition, Wiley India Pvt., 2008.  3. Solid – Liquid separation, L. Svarovsky, Fourth Edition, Butterworth-Heinmann, 2000.  **Others:**  1. Notebook prepared by the instructor of the course  2. Collection of sheets of solved and unsolved problems and Exams sheets | Required reading:  · CORE TEXTS  · COURSE MATERIALS  · OTHER |
| 1. Laboratory experiments in the (Chemical Engineering Lab)  2. Available websites related to the subject  3. Excel or similar software for the solution of lengthy problems. | Special requirements (include for example workshops, periodicals, IT software, websites) |
| 1. Field and scientific visits 2. Extra lectures by foreign guest lecturers | Community-based facilities  (include for example, guest  Lectures , internship , field studies) |

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| 13. Admissions | |
| CE241, CE342 and CE343 | Pre-requisites |
| / | Minimum number of students |
| 70 | Maximum number of students |

**Instructor**

**Teaching Assistant:**