**CHEMICAL ENGINEERING PhD PROGRAMME**

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| **First Year** |
| **I. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#EN22) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 503511603 | [ADVANCED REACTOR DESIGN](#EN15) | 7.5 | 3+0 | 3 | **C** | TR-EN |
|  | Elective Course-1 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-2 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of I. Semester  | 30 |  | 12 |  |  |
| **II. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | Turkish |
| 503512001 | PhD Seminar | 7.5 | 0+1 | - | **C** | Turkish |
|  | Total of II. Semester  | 30 |  | 12 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 24 |  |  |

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| **Second Year** |
| **III. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503511801 | PhD PROFICIENCY  | 30 | 0+1 | - | **C** | Turkish |
|  | Total of III. Semester  | 30 |  |  |  |  |
| **IV. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011102 | THESIS PROPOSAL | 30 | 0+1 | - | **C** | Turkish |
|  | Total of IV. Semester  | 30 |  |  |  |  |
|  | TOTAL OF SECOND YEAR  | 60 |  |  |  |  |

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| **Third Year** |
| **V. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503511802 | PhD THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 503511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of V. Semester  | 30 |  |  |  |  |
| **VI. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503511802 | PhD THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 503511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of VI. Semester  | 30 |  |  |  |  |
|  | TOTAL OF THIRD YEAR  | 60 |  |  |  |  |

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| **Fourth Year** |
| **VII. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 503511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | **-** | **C** | Turkish |
|  | Total of VII. Semester | 30 |  |  |  |  |
| **VIII. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 503511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of VIII. Semester | 30 |  |  |  |  |
|  | TOTAL OF FOURTH YEAR | 60 |  |  |  |  |

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| **Elective Courses** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503512607 | [ADVANCED POLYMERIC MATERIALS](#EN14) | 7.5 | 3+0 | 3 | E | Turkish |
| 503512601 | [ADVANCED WASTEWATER TREATMENT](#EN10) | 7.5 | 3+0 | 3 | E | Turkish |
| 503511608 | [BIOMIMETIC MATERIALS and SURFACE CHARACTERIZATION](#EN24) | 7.5 | 3+0 | 3 | E | Turkish |
| 503512602 | [EXERGY ANALYSIS](#EN4) | 7.5 | 3+0 | 3 | E | Turkish |
| 503511601 | [HETEROGENEOUS CATALYSIS](#EN8) | 7.5 | 3+0 | 3 | E | Turkish |
| 503512605 | [MODELING OF THE CHEMICAL PROCESSES](#EN18) | 7.5 | 3+0 | 3 | E | Turkish |
| 503511605 | [POLYMER PRODUCTION](#EN20) | 7.5 | 3+0 | 3 | E | Turkish |
| 503512606 | [RENEWABLE ENERGY SOURCES](#EN21) | 7.5 | 3+0 | 3 | E | Turkish |
| 503511604 | [STAGED SEPARATION PROCESSES](#EN16) | 7.5 | 3+0 | 3 | E | Turkish |
| 503512603 | [SYNTHESIS AND CHARACTERIZATION OF CATALYST](#EN17) | 7.5 | 3+0 | 3 | E | Turkish |

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503512602 | **TITLE** |  Exergy Analysis |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  |    |    | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework | 1 | 10 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Basic Thermodynamic Concepts; Thermomechanical Exergy; Second Law Efficiency; Exergy Property Relations; Chemical Exergy; Some Applications of Exergy Analysis Method. |
| **COURSE OBJECTIVES** |  The main aim of the course is to introduce the exergy concept and to highlighting the importance of exergy analysis in engineering. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The course gains to students the concept of the more efficient use of energy and the ways of the more efficient use of energy by exergy analysis in the chemical engineering operations. . |
| **LEARNING OUTCOMES OF THE COURSE** |  By the end of this course students will be able to:1. have an awareness of the importance of exergy in engineering2..explain the exergy concept.3. explain and discuss the second law efficiency.4. formulate the exergy balance for open and closed systems.5. perform exergy balance for open and closed systems |
| **TEXTBOOK** |  Moran, M.J., Availability Analysis: A Guide to Efficient Energy Use, Prentice-Hall, Inc., 1982. |
| **OTHER REFERENCES** |  1. Szargut, J., Morris, D.R., Steward, F.R., Exergy Analysis of Thermal, Chemical, and Metallurgical Processes, Hemisphere Publishing Corparation, 1988.2. Ahern, J.E., The Exergy Method of Energy Systems Analysis, John Wiley & Sons, 1980.3. Çengel, Y., Boles, M.A., Thermodynamics:An Engineering Approach, 7.baskı, McGraw Hill, 2011. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction and Basic Thermodynamic Concepts |
| 2 |  Thermomechanical Exergy |
| 3 |  Thermomechanical Exergy |
| 4 |  Thermomechanical Exergy |
| 5 |  Thermomechanical Exergy |
| 6 | Midterm Examination 1 |
| 7 |  Second Law Efficiencies |
| 8 |  Exergy Property Relations |
| 9 |  Exergy Property Relations |
| 10 |  Chemical Exergy |
| 11 | Midterm Examination 2 |
| 12 |  Chemical Exergy |
| 13 |  Applications of Exergy Analysis |
| 14 |  Applications of Exergy Analysis |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Prof. Dr. Hürriyet ERŞAHAN | **Date:** |  16/04/2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMISTRY (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503511601 | **TITLE** |  Heterogeneous Catalysis |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Catalysts; steps in a catalytic reaction; synthesizing a rate low, mechanism, and rate -limiting step; heterogeneous data analysis for reactor design; catalyst deactivation; packed-bed reactors; moving-bed reactors; industrial applications. |
| **COURSE OBJECTIVES** |  To teach the kinetics of heterogeneous catalytic reactions, the design of heterogeneous catalytic reactor and the industrial applications. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Ability to define, formulate and solve heterogeneous catalysis problems. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Know the base concepts of heterogeneous catalysis.2. Know the steps of heterogeneous catalytic reactions.3. Analyse the rate equations of heterogeneous catalytic reactions.4. Analyse the performance equations of heterogeneous catalytic reactors.5. Know the industrial applications of heterogeneous catalysis. |
| **TEXTBOOK** |  Fogler, H.S., Elements of Chemical Reaction Engineering, Pearson, 2005. |
| **OTHER REFERENCES** |  1. Levenspiel, O., Chemical Reaction Engineering, John Wiley, 1999.2. Satterfield, C.N., Heterogeneous Catalysis in Practice, McGraw-Hill, 1980. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Heterogeneous Catalysis |
| 2 |  Catalysts |
| 3 |  Steps In A Catalytic Reaction |
| 4 |  Synthesizing A Rate Low, Mechanism, and Rate Limiting Step |
| 5 |  Heterogeneous Data Analysis for Reactor Design |
| 6 | Midterm Examination 1 |
| 7 |  Catalyst Deactivation |
| 8 |  Packed-Bed Reactors |
| 9 |  Moving Bed Reactors |
| 10 |  Industrial Applications |
| 11 | Midterm Examination 2 |
| 12 |  Homework Presentation  |
| 13 |  Homework Presentation  |
| 14 |  Homework Presentation  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMISTRY PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Learning to use the knowledges which have been gained by undergraduate and graduate education in the postgraduate areas. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | To have a research qualification with professional responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Self - developing by following and being aware of the importance of innovation and Chemistry in the development of science and technology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | By using individual working abilities, to be capable of sharing studies and opinions in various communication media such as seminars, symposiums, congress or workshops. | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | To be capable of preparing scientific publications by using their acquired knowledge and experience in undergraduate and graduate study | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | To follow closely the developments of Chemistry in both national and international levels. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | To design and apply theoretical, experimental and modelling studies and to examine and solving complex problems encountered in these processes. | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 8** | To be capable of making disciplinary and inter-disciplinary studies. | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to make literature survey, presentation, designing and performing experiments and interpretation of relevant results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Using the ability to take initiative by acting independently. | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 11** | To have a scientific and professional ethics and defend this approach in any medium. | **[ ]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Professor Dr. Mine Özdemir | **Date:** |  17.04.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503512601 | **TITLE** |  Advanced wastewater treatment |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 1 | 2 |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  Introduction, wastewater treatment requirement, classic technologies for wastewater treatment , advanced treatment technologies for wastewater treatment , homework presentations. |
| **SHORT COURSE CONTENT** |  The basic objectives of the course; arouse students environmental awareness and to impose the idea that advanced techniques of waste water treatment to avoid issues such as eutrophication as well as environmental pollution is necessary ; In addition, analyzing and solving a related waste water engineering problem to learn advanced waste water treatment and gain the experience. |
| **COURSE OBJECTIVES** |  1.To awaken environmental awareness and development.2. Understanding some of the basic concepts and technologies related to the subject3. Following up-to-date issues , understanding The importance tracking lifelong learning, and its application4.Understand the national and global impact of engineering solutions.5. Exploring and examining A waste water treatment facility and bringing up new recommendations on treatment.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1.To awaken environmental awareness and development.2. Understanding some of the basic concepts and technologies related to the subject3. Following up-to-date issues , understanding The importance tracking lifelong learning, and its application4.Understand the national and global impact of engineering solutions.5. Exploring and examining a waste water treatment facility and bringing up new recommendations on treatment.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1.Application of information about Basic Sciences (mathematics, physics, chemistry) 2.Data analysis and evaluation.3. Bring environmental awareness4.Gain presentation experience |
| **TEXTBOOK** |  1.G. Tchobanoglous (1979) Wastewater Engineering: Treatment, Disposal, Reuse, Second Edition, Tata McGraw-Hill, New Delhi. 2. F. Şengül (1991) Endüstriyel Atıksuların Özellikleri ve Arıtılması, 2. Baskı, D.E.Ü. Mühendislik-Mimarlık Fakültesi Basım Ünitesi, İzmir. 3. H. F. Lund (Editor) (1971) Industrial Pollution Control Handbook, McGraw-Hill, New York.  |
| **OTHER REFERENCES** |  1. A. Tanyolaç ve S. S. Çelebi (Editörler) (1992) Endüstriyel Atık Su Arıtımı,TMMOB Kimya Mühendisleri Odası Ankara Şubesi, Ankara.  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction , telling the purpose and Content of the course , Giving the Exam Percentages applied for the course |
| 2 |  Need for advanced wastewater treatment, introduction to advanced treatment technologies for wastewater treatment |
| 3 |  Nitrification process, nitrogen and phosphorus removal |
| 4 |  Membrane systems |
| 5 |  Adsorption |
| 6 | Midterm Examination 1 |
| 7 |  İon exchange |
| 8 |  Chemical oxidation |
| 9 |  Elektro-coagulation |
| 10 |  Design and operation of treatment plants |
| 11 | Midterm Examination 2 |
| 12 |  Design and operation of treatment plants |
| 13 |  Oral presentation and discussion |
| 14 |  Oral presentation and discussion |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Associate professor Duygu KAVAK | **Date:** |  17.04.2015 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503502503 | **TITLE** |  Advanced polymeric materials |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 2 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Polymerization, Polymerization Processes, Catalysis, Additive Materials, Characteristics of Polymers, Sensitive Polymers, Biopolymers, Composite Polymers, identification of advanced polymers.  |
| **COURSE OBJECTIVES** |  polymer knowledge and production techniques |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Polymer concept, knowledge about the production and application of polymers |
| **LEARNING OUTCOMES OF THE COURSE** |  1-Describes and explains the basic concepts of polymers.2-Can be define the raw materials and classification of polymers, 3-Specifies the properties of polymers and production mechanism..4- May be deciding the polymer production process, and used the catalyst, initiator and other additives kinds.5-Knows the processes of industrial applications of polymers and have an idea about the processing of polymers and additives. |
| **TEXTBOOK** |  1. Erhan Pişkin, Polimer teknolojisine giriş, Anka ofset A.Ş. İstanbul, 1987Mutafa Akay, Introduction to Polymer Science and Technology,Ventus publishing Aps,2012ISBN: 978-87-403-0087-1 |
| **OTHER REFERENCES** |  All polymers books |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Polymeric substances presentation and classification |
| 2 |  Raw Materials |
| 3 |  Physical and chemical properties, bonds |
| 4 |  Molecular weight and its distribution |
| 5 |  Solution of the polymer gel |
| 6 | Midterm Examination 1 |
| 7 |  Polymer synthesis, |
| 8 |  Observes manufacturing processes |
| 9 |  Investigation of the properties of polymers |
| 10 |  Polymer processing agents and additives |
| 11 | Midterm Examination 2 |
| 12 |  Composite materials |
| 13 |  Smart polymers |
| 14 |  Biopolymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Asistant Prof. Dr. Macid Nurbaş | **Date:** |  25/04/2015 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

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**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503511604 | **TITLE** |  Staged Separation Processes |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework | 5 | 25 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  A brief discussion of the basic rules of matrix algebra, staged process; overall material balance; computer solution of the overall material balance equation; the component material balance; a computer program for solving component material balances; phase equilibrium; computer programs for equilibrium ratios and component vapor pressures; constant equilibrium ratio extraction; a program for constant equilibrium ratio extractions; constant flow rate distillation; bubble and dew point calculation; equilibrium flash calculations; The bubble point correction method for constant flow distillation. |
| **COURSE OBJECTIVES** |  To teach deriving and usage of mathematical models used for design of separation equipment. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Deriving and usage of mathematical models used for design of separation equipment. |
| **LEARNING OUTCOMES OF THE COURSE** |  By the end of this module students will be able to:1.To learn calculation methods for staged process (not graphical methods). 2.To remember main knowledge about matrix algebra.3.To solve simultaneous nonlinear equations sets for staged processes by manually and by use of computer and programming in MATLAB |
| **TEXTBOOK** |  Tierney, J.W., Notes for Staged Separations, Chemical and Petroleum Engineering Department, University of Pittsburgh, 1974. |
| **OTHER REFERENCES** |  1.Doğan, İ., A’dan Z’ye MATLAB ile çalışmak, Bileşim yayınevi, İstanbul, 2004.2.Constantinides, A., Mostoufi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  A brief discussion of the basic rules of matrix algebra, Introduction to Matlab, Basic knowledges |
| 3 |  Matrix in Matlab, Matrix operations |
| 4 |  Staged process; overall material balance |
| 5 |  Computer solution of the overall material balance equation; the component material balance |
| 6 | Midterm Examination 1 |
| 7 |  A computer program for solving component material balances; phase equilibrium |
| 8 |  Computer programs for equilibrium ratios and component vapor pressures |
| 9 |  Constant equilibrium ratio extraction; a program for constant equilibrium ratio extractions |
| 10 |  Constant flow rate distillation |
| 11 | Midterm Examination 2 |
| 12 |  Bubble and dew point calculation |
| 13 |  Equilibrium flash calculations |
| 14 |  The bubble point correction method for constant flow distillation. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Prof.Dr.Neşe Öztürk | **Date:** |  20.4.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503512605 | **TITLE** |  Modeling of the chemical processes |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 2 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Chemical Processes, Mathematical Modeling, Steady State and Non steady State Conditions, Mass Balance, Energy Balance, Momentum Balance, Batch and Continuous Sistems, Examples for Steady State and Non steady State Conditions, Stagewise Extraction and Efficiency, Distilled Water Production Process, Distillation and effeiciency, Examples for Heat transfer. |
| **COURSE OBJECTIVES** |  introduce of processes that Used in the field of chemical engineering. Modeling, mass and energy balances, and problem solutions |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Modeling of processes; teamwork ability; identification, formulate and solve the problems in the related field, use the modern methods such as computer software, techniques, |
| **LEARNING OUTCOMES OF THE COURSE** |  Providing knowledge about the modeling of chemical processes, establishingthe mass and energy balances and solution of the problems |
| **TEXTBOOK** |  McCabe L. And Smith C., Unit Operations of Chemical Engineering, McGraw Hill.  |
| **OTHER REFERENCES** |  Chemical engineering undergraduate lecture notes |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Chemical Processes |
| 2 |  Mathematical Modeling, |
| 3 |  Steady State  |
| 4 |  Non steady State Conditions |
| 5 |  Non steady State Conditions |
| 6 | Midterm Examination 1 |
| 7 |  Energy Balance Momentum Balance, |
| 8 |  Batch and Continuous Sistems |
| 9 |  Examples for Steady State and Non steady State Conditions, |
| 10 |  Stagewise Extraction and Efficiency, |
| 11 | Midterm Examination 2 |
| 12 |  Distilled Water Production Process, |
| 13 |  Distillation and effeiciency, |
| 14 |  Examples for Heat transfer. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Asistant Prof. Dr. Macid Nurbaş | **Date:** |  25/04/2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503511605 | **TITLE** |  Polymer Production |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 2 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Introduction to polymer production, Structure of a polymer, the polymer molecular weight and molecular weight distribution, polymer solution and gel condition, Polymer Melts flow, polymer synthesis, polymerization processes, polymer processing, basic properties of the polymer. |
| **COURSE OBJECTIVES** |  Introdution aboult the polimers Which is widely used in our life, Synthesis of polymers, Surveys of manufacturing processes of polymersinvestigation of polymer properties. Knowledge of polymer formation |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Polymer concept, knowledge about the production and application of polymers |
| **LEARNING OUTCOMES OF THE COURSE** |  1-Describes and explains the basic concepts of polymers.2-Can be define the raw materials and classification of polymers, 3-Specifies the properties of polymers and production mechanism..4- May be deciding the polymer production process, and used the catalyst, initiator and other additives kinds.5-Knows the processes of industrial applications of polymers and have an idea about the processing of polymers and additives. |
| **TEXTBOOK** |  Erhan Pişkin, Polimer Teknolojisine Giriş, Anka Ofset A.Ş. İstanbul, 1987. |
| **OTHER REFERENCES** |  Mutafa Akay, Introduction to Polymer Science and Technology,Ventus publishing Aps,2012ISBN: 978-87-403-0087-1 |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  polymer infomation |
| 2 |  the structure of the polymer |
| 3 |  Polymer molecular weight and molecular weight distribution |
| 4 |  Polymer solution and gel condition |
| 5 |  Flow of polymer melts |
| 6 | Midterm Examination 1 |
| 7 |  polymer synthesis |
| 8 |  Block polymerization and solution polymerization processes |
| 9 |  Suspension polymerization polymerization processes |
| 10 |  Emulsion polymerization, polymerization processes |
| 11 | Midterm Examination 2 |
| 12 |  Polymer processing |
| 13 |  Processing of the polymer and additives |
| 14 |  Basic properties of polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Assistant Prof. Dr. Macid Nurbaş | **Date:** |  25/04/2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  5035012606 | **TITLE** |  Renewable Energy Sources |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  |    |    | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) |       |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | X |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework |   |    |
| Project | 1 | 30 |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Biomass energy, production of liquid fuels from biomass, geothermal, nuclear, wind, solar, hydroelectric and hydrogen energy, characterization of synthetic fuels, reletionship of the energy and environment. |
| **COURSE OBJECTIVES** |  Determining the physical properties and amounts of alternative energy sources, their chemical compositions, designing of the energy sources, using the production units, evoluation of small scale systems and scaling up and comparing their products with those obtained from traditional sources, emphasizing their positive effects. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To discuse therelations of various diciplines with energy and determining the optimal conditions, to follow the energy technologies closely. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. State the significane renewable energy sources,2. Define the hydrogen, bor and biomass energy,3. Discuss the production of the liquid fuels,4. Classify the analysis methods of the biooils,5. Recognize the environmental effect of the energy sources. |
| **TEXTBOOK** |  1. Acaroğlu, M, ‘’ Alternatif Enerji Kaynakları’’, Atlas yayın dağıtım, 2003 |
| **OTHER REFERENCES** |  Priodicals about energy  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Renewable energy sources |
| 2 |  Hydrogen energy |
| 3 |  Bor |
| 4 |  Biomass |
| 5 |  Thermal processes |
| 6 | Midterm Examination 1 |
| 7 |  Production of liquid fuels from biomass |
| 8 |  Ethanol and methanol production processes |
| 9 |  Characterization of synthetic fuels |
| 10 |  Chromatographic methods |
| 11 | Midterm Examination 2 |
| 12 |  Spectroscopic methods |
| 13 |  Energy and environmental |
| 14 |  Presantation of the projects |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Prof. Dr. Sevgi Şensöz | **Date:** |  16.4.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  Joint Course for the Institute | **SEMESTER** |  Fall-Spring |

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| **COURSE** |
| **CODE** |  50101101 | **TITLE** |  The Scientific Research Methods and Its Ethics |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
| MSc- Ph.D | 3  | 0 | 0 | 3+0  | 7,5 | COMPULSORY( X ) | ELECTIVE(   ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 1,5 | 1,5 |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  None |
| **SHORT COURSE CONTENT** | Science, the scientific thought and other fundamental concepts, the scientific research process and its techniques, Methodology: Data Collecting-Analysis-Interpretation, Reporting the scientific research (Preparation of a thesis, oral presentation, article, project), Ethics, Ethics of scientific research and publication.  |
| **COURSE OBJECTIVES** | The main objectives are: To examine the foundations of scientific research and the scientific research methods, to teach the principles of both the methodology and the ethics, to realize the process on a scientific research and to evaluate the results of research, to teach reporting the results of research (on a thesis, presentation, article). |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Applying the scientific research methods and the ethical rules in their professional life.  |
| **LEARNING OUTCOMES OF THE COURSE** | Gaining awareness on ethical principles at basic research methods, becoming skillful at analyzing and reporting the data obtained in scientific researches, being able to have researcher qualification with occupational sense of responsibility, having the scientific and vocational ethics’ understanding and being able to defend this understanding in every medium. |
| **TEXTBOOK (Turkish)** | Karasar, N. (2015). Bilimsel Araştırma Yöntemi. Nobel Akademi Yayıncılık, Ankara.  |
| **OTHER REFERENCES** | **1-**Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., Demirel, F. (2012). Bilimsel Araştırma Yöntemleri. Pegem Akademi Yayınevi, Ankara. **2-**Tanrıöğen, A. (Editör). (2014). Bilimsel Araştırma Yöntemleri. Anı Yayıncılık, Ankara.**3-**Türkiye Bilimler Akademisi Bilim Etiği Komitesi. Bilimsel Araştırmada Etik ve Sorunları, Ankara: TÜBA Yayınları, (2002).**4-**Ekiz, D. (2009). Bilimsel Araştırma Yöntemleri: Yaklaşım, Yöntem ve Teknikler. Anı Yayıncılık, Ankara.**5-**Day, Robert A. (Çeviri: G. Aşkay Altay). (1996). Bilimsel Makale Nasıl Yazılır ve Nasıl Yayımlanır?, TÜBİTAK Yayınları, Ankara.**6-**Özdamar, K. (2003). Modern Bilimsel Araştırma Yöntemleri. Kaan Kitabevi, Eskişehir.**7-**Cebeci, S. (1997). Bilimsel Araştırma ve Yazma Teknikleri. Alfa Basım Yayım Dağıtım, İstanbul.**8-**Wilson, E. B. (1990). An Introduction to Scientific Research. Dover Pub. Inc., New York.**9-**Çömlekçi, N. (2001). Bilimsel Araştırma Yöntemi ve İstatistiksel Anlamlılık Sınamaları. Bilim Teknik Kitabevi, Eskişehir. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts) |
| 2 | Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts)  |
| 3 | The scientific research and its types (Importance of the scientific research, types of science, scientific approach) |
| 4 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)  |
| 5 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)  |
| 6 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)  |
| 7 | The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data) |
| 8 | The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data) |
| 9 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 10 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 11 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 12 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 13 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 14 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 15,16 | Mid-term exam, Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE INSTITUTE’S GRADUATE PROGRAMME’S LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (M.Sc.-Ph.D.)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Having the scientific and vocational ethics’ understanding and being able to defend this understanding in every medium. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Being able to have researcher qualification with occupational sense of responsibility.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Becoming skillful at analyzing and reporting the data obtained in scientific researches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Gaining awareness on ethical principles at basic research methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |   | **Date:** |  14.06.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |   BIOMIMETIC MATERIALS and SURFACE CHARACTERIZATION  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) |  Turkish  |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 45 |
| **PREREQUISITE(S)** |  not |
| **SHORT COURSE CONTENT** |  Definition of biomimetic materials and nanotechnology, development processes, technological applications, superior properties, surface characterization techniques, determination of structural and thermal properties, environmentally friendly materials, paint, textile, technical, ecological and health applications  |
| **COURSE OBJECTIVES** |  This course provides students with knowledge of biomimetic materials and fundamentals and application areas of nanotechnology, and methods of synthesis (production) and characterization of these materials. It aims to raise awareness of its current and future potential applications, and to present the latest developments in nanoscale advanced materials and devices.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Learning the fundamentals of biomimetic materials and nanomaterials. Learning the basics of surface characterization. To have knowledge about the recent applications of nanotechnology. Contributes to master's / doctorate thesis studies and projects.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Understanding the basics of biomimetic materials and surface characterizationEvaluating the environmental applications of biomimetic materials and nanomaterials,Understanding of choosing suitable processes, materials and technology for industrial applications,Evaluating the recent applications of biomimetic materials and nanotechnology.      |
| **TEXTBOOK** |  Fundamentals of Materials Science and Engineering, William D.Callister, David G.Rethwisch, John Wiley & Sons, 2008. J.C.Vickerman “Surface Analysis” John Wiley&Sons, 2004.  |
| **OTHER REFERENCES** |  Vincent JFV, Bogatyreva OA, Bogatyrev NR, Bowyer A, Pahl AK,Biomimetics: its practice and theory.,2006.Gary E. McGuire, Stephen M. Rossnagel, Rointan F.Bunshah, Materials science and Processing Technology Series. 2001.Huber T, Müssig J, Curnow O, Pang S, Bickerton S, Staiger MP, A critical review of all-cellulose composites. J. Mater. Sci., 47, 1171–1186, 2012.Borisenko, Victor E., and Stefano Ossicini. What is What in the Nanoworld: Handbook on Nanoscience and Nanotechnology. Weinheim: Wiley-VCH, 2005. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Biomimetic Materials and Nanotechnology  |
| 2 |  High-Tech Materials  |
| 3 |  Smart materials  |
| 4 |  Advanced Ceramic Materials and Properties  |
| 5 |  Surface Characterization  |
| 6 |  Hydrophilic Surfaces  |
| 7 |  Hydrophobic Surfaces  |
| 8 |  Mid-Term Examination  |
| 9 |  Green Composites  |
| 10 |  Biomimetic Surface Designs  |
| 11 |  Biomimetic Materials and their applications  |
| 12 |  Nanotechnological applications of biomimetic surfaces  |
| 13 |  homework presentations  |
| 14 |  homework presentations  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Doç. Dr. Ceyda BİLGİÇ | **Date:** |  13.10.2020 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503511603 | **TITLE** |  Advanced Reactor Design  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework | 1 | 20 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  None |
| **SHORT COURSE CONTENT** |  Nonideal flow and residence time distribution (RTD); RTD for ideal reactors; laminar flow reactor; tanks in series model;partial TKSR, partial PAR and partial short-circuiting system; fluidized bed reactor; dispersion model; derivation ofperformance equations of reactor by RTD; zero parameter system; segregation and mixing models; single parameter system. |
| **COURSE OBJECTIVES** |  To teach reactor design principle include residence time distribution (RTD), appropriate model for ideal and nonideal reactor,derived performance equations of reactor from new approaches, to gain talent for application of mathematical operations asdifferential equation systems, limit values, partial differential equation systems and curves, to gain knowledge and skill abouthemical kinetic and reaction engineering. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Development of reactor design. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. To define residence time distribution (RTD) and ideal/nonideal flow in the chemical reactors by used relevantmeasurements.2. To conceive the required models for PAR/TKSR series, laminar flow reactor, partial TKSR-partial PAR and partial shortcircuitingsystem, fluidized bed reactor.3. To perform the required models for diffusion, conduction and mass transfer to associate chemical reactions.4. To understand derived performance equations of reactor from new approaches.5. To carry out mathematical operations as differential equation systems, limit values, partial differential equation systemsand curves6. To perform literature survey on a selected subject (for example: fuel cell, membrane reactors, catalytic converter,enzyme-substrate kinetics etc.) and to be able to do design, conclude and present the results.Please write minimum four learning outcomes for the course. |
| **TEXTBOOK** |  1.. H. Scott Fogler, Elements of Chemical Reaction Engineering, 3rd Ed, Prentice Hall Inc. 1999.2. O. Levenspiel, Chemical Reaction Engineering, John Wiley&Sons, 1972.3. L.D. Schmidt, The Engineering of Chemical Reactions, Oxford University Press, 1998.4. M. Davis and R. Davis, Fundamentals of Chemical Reaction Engineering, Mc Graw Hill 2003. |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Residence time distribution (RTD) and ideal/nonideal flow in the chemical reactors, relevant measurements. |
| 2 |  PAR/TKSR series, laminar flow reactor. |
| 3 |  Partial TKSR-partial PAR and partial shortcircuiting system, fluidized bed reactor. |
| 4 |  The required models for diffusion, conduction and mass transfer to associate chemical reactions. |
| 5 |  The required models for diffusion, conduction and mass transfer to associate chemical reactions. |
| 6 | Midterm Examination 1 |
| 7 |  The performance equations of reactor from new approaches. |
| 8 |  The performance equations of reactor from new approaches. |
| 9 |  The mathematical operations as differential equation systems, limit values, partial differential equation systems and curves |
| 10 |  The mathematical operations as differential equation systems, limit values, partial differential equation systems and curves |
| 11 | Midterm Examination 2 |
| 12 |  Homework follow-up and discussion |
| 13 |  Homework presentation |
| 14 |  Homework presentation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc.Prof. T.Ennil KÖSE | **Date:** |  20/04/2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** |  **CHEMICAL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |   | **TITLE** |  Synthesis and Characterization of Catalyst  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
| **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY( x ) | ELECTIVE(   ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 1 |   |  2  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 40 |
| Quiz |   |    |
| Homework | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 30 |
| **PREREQUISITE(S)** |  None |
| **SHORT COURSE CONTENT** |  Introduction, Bulk and supported catalysts, Support materials, Fundamentals of catalyst preparation, Precipitation method, Impregnation method, Catalyst supports, Physical characterization and Examination, Supported metal catalysts; homework presentations. |
| **COURSE OBJECTIVES** |  The main aims of this course are to give knowledge about the synthesis and characterization of solid catalysts which are widely used in Chemical Engineering.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students learn about bulk and supported catalysts, get knowledge of synthesis and characterization of catalysts, find out support materials and its properties, get the experience of incorporating in a team work and individual study by doing homework; in addition to these; they will be able to engage in life-long learning and get application skills. |
| **LEARNING OUTCOMES OF THE COURSE** |  By the end of this module students will be able to:1. Apply knowledge of mathematics, science, and engineering.2. Identify, formulate, and solve engineering problems3. Grasp analogies between momentum, heat, and mass transfer.4. Comprehend some mass transfer models.5. Strengthen chemical engineering applications via solving numerous problems.6. Get recognition of the need for, and an ability to engage in life-long learning.7. Gain experience on teamwork and presentation via term project. |
| **TEXTBOOK** |  Charles N. Satterfield, Heterogeneous Catalysis in Practice, McGraw-Hill Book Company 1980.  |
| **OTHER REFERENCES** |  1. Ertl, G., Knozinger, H., Weitkamp,J., Preparation of Solid Catalysts,Wiley, 1999.2. Regalbuto, J., Catalyst Preparation: Science and Engineering, Taylor & Francis, 2006.3. Haw, J.W., In-situ Spectroscopy in Heterogeneous Catalysis, Wiley-VCH Verlag GmbH, 2007.4. Charles N. Satterfield, Heterogeneous Catalysis in Practice, McGraw-Hill Book Company 1980. 5. Krijn P. de Jong, Synthesis of Solid Catalysts, John Wiley & Sons, 2009.  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction, Bulk and supported catalysts |
| 2 |  Fundamentals of catalyst preparation |
| 3 |  Precipitation method, Calcination, Reduction tok the metal, Impregnation method |
| 4 |  Precipitation method, Calcination, Reduction tok the metal, Impregnation method |
| 5 |  Physical characterization and Examination |
| 6 | Midterm Examination 1 |
| 7 |  Measurement of surface area, Pore volume, Pore-size distrubution |
| 8 |  Mechanical properties |
| 9 |  Instrumental methods |
| 10 |  Supported metal catalysts |
| 11 | Midterm Examination 2 |
| 12 |  Metal dispersion, Alloy catalysts |
| 13 |  Properties and Characteristics of Industrial Catalysts |
| 14 |  Homework presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CHEMICAL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to understand and apply the most advanced levels of mathematics, science and engineering knowledge in chemical engineering and other related areas | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to design, plan, supervise, conduct, conclude and apply the original research and investigation processes for innovative scientific and technological studies, by obtaining the up-to-date knowledge, in chemical engineering and other related areas | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to design, plan, supervise, conduct, conclude and apply the innovative multi-disciplinary studies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to submit and publish the outcomes of academic studies in all kinds of respectable academic media | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of written, oral and visual communication, in advanced level, in at least one foreign language | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to analyze, synthesize, evaluate and criticize the arisen, suggested and/or submitted ideas in the study area | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to assess the up-to-date scientific, technological, social, cultural and environmental issues, having the awareness of ethics and responsibility in all these areas | **[ ]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Yrd. Doç. Dr. Alime ÇITAK | **Date:** |  17.04.2015 |

**Signature**: