**POLYMER SCIENCE AND TECHNOLOGY 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](#EN33) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 505411601 | [SYNTHESIS AND CHARACTERIZATION OF MACROMOLECULES](#EN32) | 7.5 | 3+0 | 3 | **C** | Turkish |
|  | 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 |
| 505412601 | [FUNCTIONAL POLYMERS AND MODIFICATIONS](#EN31) | 7.5 | 3+0 | 3 | **C** | Turkish |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
| 505412001 | PhD Seminar | 7.5 | 0+1 | - | **C** | Turkish |
|  | Total of II. Semester | 30 |  | 9 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 21 |  |  |

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| **Second Year** | | | | | | |
| **III. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505411801 | 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 |
| 505411802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505411803 | 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 |
| 505411802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505411803 | 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 |
| 505411802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505411803 | 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 |
| 505411802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505411803 | 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 |
| 505411602 | [ELECTROCHROMIC AND PHOTOCHROMIC POLYMERS](#EN7) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411603 | [PHYSICAL CHEMISTRY OF POLYMER SOLUTIONS](#EN18) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411604 | [PHYSICS OF MACROMOLECULES](#EN19) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411605 | [POLYMER PHOTOCHEMISTRY](#EN23) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411606 | [CHEMISTRY OF NANOMATERIALS](#EN5) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411607 | [PHYSICAL CHEMISTRY OF MACROMOLECULES](#EN17) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411608 | [POLYMER COMPOSITES](#EN20) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411609 | [Advanced Liquid NMR Techniques](#EN35) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412602 | [ELECTROPOLYMERIC NANOSTRUCTURES](#EN8) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412603 | [ANALYSIS AND CHARACTERIZATION METHODS IN SURFACE CHEMISTRY](#EN3) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412604 | [MECHANICAL PROPERTIES OF MACROMOLECULES](#EN14) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412605 | [SYNTHESIS OF NANOPARTICLES](#EN29) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412606 | [POLYMER GELS AND NETWORK STRUCTURES](#EN22) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412607 | [WATER SOLUBLE AND SWELLABLE POLYMERS](#EN30) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412608 | [MEMBRANE TECHNOLOGY](#EN15) | 7.5 | 3+0 | 3 | E | Turkish |
| 505412609 | [Advanced Solid NMR Techniques](#EN34) | 7.5 | 3+0 | 3 | E | Turkish |
| 505411901 | [POLYMER COMPOSITES](#d28) | 7.5 | 3+0 | 3 | E | English |
| 505412901 | [FUNCTIONAL POLYMERS ANS MODIFICATIONS](#d32) | 7.5 | 3+0 | 3 | E | English |

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

|  |  |  |  |
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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401501 | **TITLE** | Fundamentals of Polymer Chemistry |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction, definitions, nomenclature and uses of polymers, tacticity, polymer structure and classification, molecular weights, the physical properties of polymers, crystallization, Dc, Tm and Tg, viscosity, step-growth polymerization, free radical polymerization, anionic polymerization, cationic polymerization, Zeigler-Natta polymerization, ring opening polymerization, copolymerization and copolymers, other polymerization techniques: Mass, solvents, dispersion, suspension, emulsion polymerizations. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To understand the meaning and importance of polymers that holds an important place in our daily live. To gain experience on the design, synthesis and characterization of polymeric materials.  Having information about the properties and applications of polymers.  To train of individuals equipped with sufficient polymer chemistry in accordance with the needs of the sector. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To contribute individuals who have knowledge about polymer science and technology | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Recognize a wide range of polymers  2. Calculate mol weight tand comprehend the importance of MOL weights,  3.Define the properties of polymers in the solid state,  4.Understand the kinetics of both chain polymerization and step-growth polymerisations.  5. Makes a comparison between anionic and free radical polymerization,  6. Define and illustrate Zeigler-Natta and cationic polymerisations  7. distinguishes between bulk, solution and precipitation polymerizations | | | | | | | |
| **TEXTBOOK** | | | | | Polimer Kimyası (M. Saçak, Gazi yayınları) | | | | | | | |
| **OTHER REFERENCES** | | | | | Textbook of Polymer Science (Billmeyer)Polymers:Chemistry and Physics of Modern Materials (JMG Cowie-1991)Principles of Polymerisation (Odian) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, definitions, nomenclature, |
| 2 | polymer structure and classification, |
| 3 | polymer areas, taktisite, molecular weights, |
| 4 | Physical properties of polymers, crystallization, DC, Tm and Tg, |
| 5 | viscosity, |
| 6 | Midterm Examination 1 |
| 7 | Stepwise polymerization, free radical polymerization, |
| 8 | Anionic polymerization, cationic polymerization, |
| 9 | Zeigler-Natta polymerization, ring opening polymerization |
| 10 | Copolymerization and copolymers |
| 11 | Midterm Examination 2 |
| 12 | Other technological polymerization techniques: mass and solution polymerizations. |
| 13 | Other technological polymerization techniques: Dispersion, suspension polymerizations. |
| 14 | Other technological polymerization techniques: Emulsion polymerization. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Vural Bütün **Date:**  02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402501 | **TITLE** | Polymer Characterization |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | An overview of polymer characterization methods.  Purification: Precipitation, vacuum drying, rotary evaporator, freeze dryer, extraction. Methods of molecular weight determination: Gel permeation chromatography, colligative properties, viscosity measurements, end-group analysis H NMR spectroscopy. To determine the Mw using X-Ray, SANS, SAXS, static light scattering. The other spectroscopic methods: IR, FT-IR, UV-vis. Proton and C-13 NMR structure analysis-kinetic working principles. Thermal Characterizations: DTA, DSC, TGA. Zeta potentiometer, surface tension, densimeter. To determine the hydrodynamic properties of polymers using in liquid media DLS method. Polymer morphology, the glass transition temperature and the degree of crystal. Conformational Analysis of Polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To learn the methods that can be used to provide structure elucidation of polymers. Ensure that students face in the industry to gain familiarity with the device and methods and to facilitate adaptation to the sector. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Pre-recognition devices are widely used in industry: GPC, X-ray, IR, UV, proton and carbon-13 NMR. If you need to have prior knowledge of the use of these devices to be in business. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Polymer molecular weights and measurement principles can assess which methods and devices know.  2. Determination of structures of polymers diffraction, scattering, thermal and spectroscopic methods will have to use the equipment.  3. Morphology of polymers, glass transition temperature and the degree of crystal can identify and conformational analysis. | | | | | | | |
| **TEXTBOOK** | | | | | 1. Polymer Chemistry A Practical Aproach”, Ed. F. J. Davis, Oxford University Pres. UK-2004 | | | | | | | |
| **OTHER REFERENCES** | | | | | 2. Light Scattering from Polymer Solutions and Nanoparticle Dispersions”, W. Schartl, Germany, Springer-Verlag Berlin Heidelberg 20073. “NMR Spect. and Polymer Microstruct”, A. E. Tonelli, VCH Publishers, Inc, 19894. Polymers: Chem and Phy of Modern Materials”, J.M.G. Cowie, 2nd Ed. 1991, UK5. Contemporary Polymer Chemistry”, H.R. Allcock, F.W. lampe, J. E. Mark, 3rd ed. 2003, New Jersey - USA | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | An overview of the methods of polymer characterization |
| 2 | Polymer purification: Precipitation, vacuum drying, rotary evaporator, freeze dryer, extraction |
| 3 | Methods of molecular weight determination: Gel permeation chromatography (GPC) |
| 4 | Molecular weight determination methods: Colligative properties, viscosity measurements |
| 5 | Molecular weight determination methods: End-group analysis, proton NMR spectroscopy |
| 6 | Midterm Examination 1 |
| 7 | To determine the Mw using X-Ray, SANS, SAXS, static light scattering |
| 8 | The other spectroscopic methods: IR, FT-IR, UV-vis |
| 9 | Proton and carbon-13 NMR structure analysis-kinetic working principles |
| 10 | Thermal Characterizations: DTA, DSC, TGA |
| 11 | Midterm Examination 2 |
| 12 | Zeta potentiometer, surface tension, densimeter |
| 13 | To determine the hydrodynamic properties of polymers using in liquid media DLS method. |
| 14 | Polymer morphology, the glass transition temperature and the degree of crystal, Conformational Analysis of Polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412603 | **TITLE** | Analysis and Characterization Methods in Surface Chemistry |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **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** | | | | | Surface energy, contact angle and surface tension measurement methods. Basic principles of adsorption, adsorption thermodynamics, adsorption isotherms, gas adsorption, adsorption from solutions, industrial applications of adsorption, catalytic applications, surface activity, wetting, CMC, determination of micelle size and micelle shape, light scattering, determination of particular size, colloidal systems. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To give knowledge about physical chemistry and thermodynamics of interfacial processes in the industries such as cosmetic, textile, dye, detergent and ore flotation, waste treatment etc. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Give a basic background on Analysis and Characterization Methods in Surface Chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Be familiar to surface tension  2. Describe surface tension and know measurement methods  3. Gain information about wetting, detergency, surfactants, miscellaneous.  4. Create adsorption isotherms and formulate equations.  5. Know about industrial applications of adsorption  6. Be familiar to colloidal systems and its industrial applications  7. Be aware of the of surface chemistry in the industrial applications. | | | | | | | |
| **TEXTBOOK** | | | | | Shaw D. J., “Introduction to Coll and Surface Chem”, Butterworths, 1992. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Erbil, H. Y., “Solid and Liquid Interfaces”, Blackwell Publishing, 2006. 2. Gabor A. S. Yimin L., Introd. to Surface Chem and Catalysis, John Wiley&Sons, 2010. 3. Gregg, S.J. Sing, K.S.W., Adsorption, Surface Area and Porosity, Academic Pres, London, 1982. 4. Rouquerol, F., Rouquerol, J. Sing, K., Adsorption by Powders and Porous Solids, Acad.Press, London, 1999. 5. Ruthven, D.M., Principles of Adsorption and Adsorption Proc. Wiley-Intersci. Pub., New York, 1984. 6. Crittenden, B. Thomas, W.J., Adsorption Technology and Design, Butterworth-Heinemann, Oxford, 1998 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to surface chemistry and giving project topics |
| 2 | Liquid-gas interfaces (surface tension and surface tension measurement methods, applications of theLaplace equation, Kelvin equation, Jurin Theory) |
| 3 | Liquid-liquid interfaces ( surfactants and properties of the surfactants) |
| 4 | CMC, determination of micelle size and micelle shape |
| 5 | Solid-liquid interfaces (contact angle, wetting and detergency) |
| 6 | Midterm Examination 1 |
| 7 | Gas-solid interfaces (thermodynamic of the adsorption and types of adsorption, adsorption isotherms, gas adsorption) |
| 8 | adsorption from solutions |
| 9 | industrial applications of adsorption, catalytic applications |
| 10 | Colloidal systems and its industrial applications |
| 11 | Midterm Examination 2 |
| 12 | light scattering, determination of particular size |
| 13 | Student presantations |
| 14 | Student presantations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Ayşegül Aşkın **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402507 | **TITLE** | Biopolymers |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 25 |
| Quiz | | | | | 1 | | 25 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Potential producers of polymers for the production of microbial properties of the course will be described. Microbial properties of polymer production mediums and production techniques will be discussed in detail. The medium of production of biopolymers can be used to obtain the described techniques. These poly hydroxy butyrate production techniques and production methods and the hyaluronic acid production and extraction as a model by applying explained. The differences between bacterial and fungal polymers and their uses will be discussed. Biocompatibility testing methods used in the investigation of the antimicrobial activity of biopolymers in practice will be described. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The course of biopolymers chemistry, physics, biology and engineering, and their all important aspects related to biotechnology and biomedical applications of theoretical lectures, practice, discussions and presentations explaining and aims to teach. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | This course will contribute students to produce polymers using a variety of microorganisms. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1."Biopolymer" and general materials should be covered by the definition to describe the difference,  2. What type of biopolymers used in biology and medicine, and it is important to learn which specific features,  3. Explain the interactions between the biopolymer and the tissue,  4. Learn how to nano-scale will be modified according to the desired purpose of biopolymer,  5. Explain applications of nano structure of biopolymers, | | | | | | | |
| **TEXTBOOK** | | | | | R.M. Johnson, L.Y. Mwaikambo and N. Tucker, Biopolymers, Shrewsbury, U.K. : Rapra Technology, 2003 | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Ratner B. D., Hoffman A. S., Schoen F. J. Lemons J. E., Biomaterials Sci: An Intr. to Materials in Medicine, 2nd edn. Elsevier Acad Press, 2004.2. Hari Singh Nalwa, “Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology”, American Scientific Publishers, 2005.3. Rehm, B.H.A., Microbial Bionanotechnology, hofizon bioscience, 20064. Steinbüchel A., Marchessault R.H., Biopolymers for Medical and Pharmaceutical applications, Wiley ICH, 20055. Rehm B.H.A., Microbial production of Biopolymers and polymer precursor, Caister Academic Press, 2009. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Polymer producer microorganisms, bacteria |
| 2 | Polymer producer microorganisms, Fungi |
| 3 | Polymer producer microorganisms, Algae |
| 4 | Biodegradability, Environmental importance |
| 5 | Economic impact of biopolymers, market share |
| 6 | Midterm Examination 1 |
| 7 | Biopolymer synthesis, cellulose, hemicelluloses, starch |
| 8 | Biopolymer synthesis, polyhydroxyalchonate, tannin |
| 9 | Biopolymer synthesis, polyactic acid, lignin |
| 10 | Biopolymers that are available commercially |
| 11 | Midterm Examination 2 |
| 12 | Areas of Biopolymers |
| 13 | Pharmaceutical biopolymers |
| 14 | Production from waste biopolymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Ahmet ÇABUK **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411606 | **TITLE** | Chemistry of Nanomaterials |

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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 | | x | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Strategies for the synthesis of nano-sized materials, polymeric, metal and semi-conductor nanocrystals properties, improved methods for the synthesis of nano-particles, latex technology, nano-tubes and nano-wires, nano-metals, cross-linked nanostructured polymers, shell cross-linked micelles, microgels, nano catalyzers, nano-porous materials, electro and photochemistry of nano particles. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Nano-scale materials design, obtain in-depth information on the synthesis and characterization of, and properties of nanomaterials and provide that they are aware of areas of application. Among the branches of today's leading technology in the field of nanotechnology and nanomaterials thus equipped to cater to the need of individuals providing the growth of the sector. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Provide that the student has a solid infrastructure nanochemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students will understand the concept of nanotechnology today.  2. Students comprehend the relationship between particle size-property.  3. Students will learn about methods for nanoparticle synthesis.  4. Students realize that size amenities and losses due to changes in the application. | | | | | | | |
| **TEXTBOOK** | | | | | Nanomaterials and Nanochemistry, 2006, C. Br´echignac P. Houdy M. Lahmani, Berlin, France. | | | | | | | |
| **OTHER REFERENCES** | | | | | Materials Science and Engineering Handbook, 3rd Ed., JF Shackelford, W Alexander, CRC Press, USA 2001 Nanomaterials: From Research to Appl., 2006, H.Sonoko ve ark.. Controlled Synthesis of Nanoparticles in Microheterogeneous Systems, 2006-Springer, V. T. Liveri Metal nanoparticles: Synthesis, Characterization and Appl., 2002, D.L. Feldheim and G.A. Foss, USA, NY. Emissive Materials.Nanomaterials, 2006, A. Abe ve arkadaşları Polymer nanocomposites, 2006, Edited by Yiu-Wing Mai and Zhong-Zhen Yu. Published by Woodhead Publishing Limited, Abington Hall, Abington,Cambridge CB1 6AH, England. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, pre-concept;nano buldings |
| 2 | Strategies for the synthesis of nano-sized materials |
| 3 | Properties of polymeric,nano-structures |
| 4 | Metal and semi-conductor nanocrystals properties |
| 5 | Photochromic viologen-based systems |
| 6 | Midterm Examination 1 |
| 7 | Latex technology |
| 8 | Nano-tubes and nano-wires |
| 9 | Cross-linked nanostructured polymers, shell cross-linked micelles |
| 10 | Organic systems(bipyridilium systems) |
| 11 | Midterm Examination 2 |
| 12 | Microgels |
| 13 | Nano-porous materials, |
| 14 | Electro and photochemistry of nano particles,environmental and nanoparticle technology |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402506 | **TITLE** | Conducting Polymers |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 50 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Conductive polymer identification, theory of conductivity of conductive polymers, conductive polymers, applications, methods of synthesis of conductive polymers, conductive polymers, polymerization mechanisms, and applications of conductive polymers | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course to teach synthesis of conducting polymers and its some of applications. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will have the ability to interpret the industrial area will need. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Define the conducting polymers, describe the general synthesis methods of conducting polymers, learn the polymerization mechanism of conducting polymer, gain knowledge about synthesis conducting polymers using electrochemical methods, learn some of applications obtained conducting polymers. | | | | | | | |
| **TEXTBOOK** | | | | | Conductive Electroactive Polymers: Intelligent Polymer Systems, Gordon G. Wallace, Geoffrey M. Spinks, Leon A. P. Kane-Maguire, and Peter R. Teasdale | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Thesis about conducting polymers.2. Journals related with conducting polymer and its applications.3. Conductive Polymers and Plastics: In Industrial Applications, Larry Rup | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Basis of conducting polymers |
| 2 | Conductivity properties |
| 3 | Doping reactions |
| 4 | Doped by itself conducting polymer |
| 5 | Semi-conductive models for conducting polymers |
| 6 | Midterm Examination 1 |
| 7 | Electrochromic properties |
| 8 | Solibility and workability of conducting polymers |
| 9 | Characterization methods |
| 10 | Characterization methods |
| 11 | Midterm Examination 2 |
| 12 | Sensor applications of conducting polymers |
| 13 | Solar cell applications of conducting polymers |
| 14 | Supercapacitor applications of conducting polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Assoc. Prof. Evrim HÜR **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411602 | **TITLE** | Electrochromic and Photochromic Polymers |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 50 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Fundamental principles of photochemistry and electrochemistry. Electrochromic systems; kinetics and mechanism, construction of electrochromic device, Electroactive conductive polymers and other organic electrochromes. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The objective of this course is; to gain knowledge on fundamental principles and mechanisms of chromism of the monomeric and polymeric materials by photochemical and electrochemical route and to meet the needs for the application areas. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will have the ability to interpret the industrial area will need. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Basic concepts and electrochemical characterization,  2. Kromizm, Photochromism, electrochromism,  3. High and low molecular weight chromic systems,  4. To have information about last developments. | | | | | | | |
| **TEXTBOOK** | | | | | Electrochromism: Fundamental and Applications. Paul M. S. Monk, Roger J. Mortimer, David R. Rosseinsky.Verlagsgesellschaft. 1995. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Applied Photochromic Polymer Systems. C. B. McArdle , Charmann Hall Edn. 1992. 2. Electrochemical Methods Fundamental and Applications 2nd Ed. Allen J. Bard, Larry R. Faulkner John Wiley and Sons 2001. 3. Handbook of Conducting Polymers. Terje A. Skotheim, Marcel Dekker, 1986. 4. Electrochromism and Electrochromic Devices. Monk, Paul et al Cambridge University Press, United Kingdom, 2004. 5. Electrochromic Materials and Applications, Rougier, USA, 2003. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Fundamental principles of photochemistry and electrochemistry |
| 2 | Optical applications of organic photochromic polymer systems(Spirooxazines, fulgides and fulgimides) |
| 3 | Photochromic liquid crystal polymers |
| 4 | Photostimulated conformation changes of polymers in solution and gel phases |
| 5 | Photochromic viologen-based systems |
| 6 | Midterm Examination 1 |
| 7 | Electrochromism |
| 8 | Electrochromic systems; kinetics and mechanism, construction of electrochromic device |
| 9 | Inorganic electrochromic systems(metal oxides, phtalocyanine compounds, prussian blue) |
| 10 | Organic electrochromic systems (bipyridilium systems) |
| 11 | Midterm Examination 2 |
| 12 | Electroactive conductive polymers and other organic electrochromes |
| 13 | Polyelectrochromism |
| 14 | Photoelectrochromism and electrochromic printing |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Assoc. Prof. Evrim HÜR **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412602 | **TITLE** | Electropolymeric Nanostructures |

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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 | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Kinetics of electrode processes, electrochemical techniques, cyclic voltammetry, in-situ electrochemistry, oxidation and reduction reactions of monomers, electropolymerization, electroactive polymeric nanostructures, (polyaniline, polythiophene, polypyrrole, polyalkylenedioxythiophene and their copolymers), characterization of electropolymers, applications of electropolymers, electrochromic devices, sensors, batteries, supercapacitors. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To teach meaning and importance of nanostructures, to exemplify electropolymeric nanostructures and to explain the properties of electropolymeric nanostructures, to provide having detailed information about the applications of nanostructures in addition to synthesis and characterization methods of electropolymeric nanostructures. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To contribute to the education of individuals who are equipped with nanostructured electro polymers that are the current research topics in recent years. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Understand the concept of electropolymeric nanostructures  2. Know the characterization methods of electropolymeric nanostructures  3. Know the synthesis methods of electropolymeric nanostructures  4. Exemplify current applications of electropolymers. | | | | | | | |
| **TEXTBOOK** | | | | | A. Eftekhari, Nanostructured Conductive Polymers, Wiley-VCH, 2010. | | | | | | | |
| **OTHER REFERENCES** | | | | | S. Cosnier, A. Karyakin, Electropolymerization, Consepts, Materials and Applications, Wiley-VCH, 2010. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Kinetics of electrode processes |
| 2 | Electrochemical techniques |
| 3 | Cyclic voltammetry |
| 4 | Oxidation and reduction reactions of monomers |
| 5 | In-situ electrochemistry, electropolymerization |
| 6 | Midterm Examination 1 |
| 7 | Electroactive polymeric micro and nanostructures (polyaniline, polypyrrole, polyalkylenedioxythiophene and their copolymers) |
| 8 | Spectroscopic characterization tecniques of electropolymers |
| 9 | Microscopic characterization tecniques of electropolymers |
| 10 | Applications of electropolymers |
| 11 | Midterm Examination 2 |
| 12 | Electrochromic devices |
| 13 | Sensors, biosensors |
| 14 | Batteries, supercapacitors |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Gözen Bereket **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402503 | **TITLE** | Heterogeneous Polymerization Systems |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Overview of polymer hydrodynamics. Diffusion in solution. Sedimentation in solution. The solution viscosity. Polyelectrolyte. Multi-component systems containing macromolecules. Heterogeneous polymerization systems. Surface active agents. Emulsifying agents. Stabilizers. Emulsion polymerization techniques, types of emulsions. Mechanism of emulsion polymerization. Kinetics of emulsion polymerization. Suspension polymerization, dispersion polymerization. Industrial applications of heterogeneous polymerization systems. Industrial heterogeneous polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To understand the meaning and importance of the heterogeneous polymerization systems, to introduce and illustrate the concepts of polyelectrolyte and surfactant, to give detailed information about emulsion, suspension and dispersion polymerization techniques. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | The basics and applications of heterogeneous polymerization techniques which are widely used in industry will be learned. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Define the concept of heterogeneous polymerization system,  2. Explain emulsion, suspension and dispersion polymerization techniques, 3. Exemplify applications of heterogeneous polymer systems. | | | | | | | |
| **TEXTBOOK** | | | | | V.T. Liveri, Controlled Synthesis of Nanoparticles in Microheterogeneous Systems, Springer, 2006. | | | | | | | |
| **OTHER REFERENCES** | | | | | H.Y. Erbil, Vinyl Acetate Emulsion Polymerization and Copolymerization with Acrylic Monomers, CRC Press, 2000. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Overview of polymer hydrodynamics |
| 2 | Diffusion in solution and sedimentation in solution |
| 3 | The solution viscosity, polyelectrolyte |
| 4 | Multi-component systems containing macromolecules |
| 5 | Heterogeneous polymerization systems |
| 6 | Midterm Examination 1 |
| 7 | Surface active agents, emulsifying agents, stabilizers |
| 8 | Emulsion polymerization techniques, types of emulsions |
| 9 | Mechanism of emulsion polymerization |
| 10 | Kinetics of emulsion polymerization |
| 11 | Midterm Examination 2 |
| 12 | Suspension polymerization |
| 13 | Dispersion polymerization |
| 14 | Industrial applications of heterogeneous polymerization systems and industrial heterogeneous polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Doç. Dr. Berrin DURAN **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 5505401508 | **TITLE** | Industrial Adhesives |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 50 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The introduction to adhesives, solvents, the classification of adhesives, thermosets, thermoplastic adhesives, elastomers and synthetic elastomers, silicon polymers, natural adhesives, the application of adhesives | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The purpose of this course, students generally provide information about industrial adhesives, adhesive industry, the importance of the understanding of polymeric additives adhesives. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Adhesives business sector will have the basic knowledge needed. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. The classification of adhesives  2.The adhesive materials and their properties  3. The Industrial application of adhesives  4. They learn about the new adhesives in the adhesive industry. | | | | | | | |
| **TEXTBOOK** | | | | | Ana Hatlarıyla Yapıştırıcılar, F. Kaya,2004 Birsen Yayınevi | | | | | | | |
| **OTHER REFERENCES** | | | | | 1..Ana Hatlarıyla Plastikler ve Katkı maddeleri, .F.Kaya,2005 Birsen Yayınevi2. Polimer Kimyası, M.Saçak,2002,Gazi Kitapevi | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | The Introduction to Adhesives |
| 2 | Solvents |
| 3 | The Classification of Adhesives |
| 4 | Thermosets |
| 5 | Thermosets |
| 6 | Midterm Examination 1 |
| 7 | Thermoplastic Adhesives |
| 8 | Thermoplastic Adhesives |
| 9 | Elastomers and Synthetic Elastomers |
| 10 | Silicon Polymers |
| 11 | Midterm Examination 2 |
| 12 | Natural Adhesives |
| 13 | Mastics |
| 14 | The application of Adhesives |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Assoc. Prof. Dr. Taner ARSLAN **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401507 | **TITLE** | Industrial Polymers |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The historical development of polymers and their classification; the definition of industrial polymers, general properties of polymeric materials, monomer synthesis, industrial polymers, thermoplastics, thermosets, polymer production technologies, foams, additives materrials, recovery | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Understanding the meaning and importance of plastics,  Introducing the world of polymer more closely.  Ability to obtain general information about the acquisition of production-processing processes,  Gaining some common knowledge about polymer properties and application areas  By educating individuals with sufficient knowledge of commercial polymer, it will be easier for them to adapt to the related sectors. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Allows the student to have important knowledge on industrial polymers | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Recognize a wide range of industrial polymers,  2. Know the plastics industry in Turkey  3. Have knowledge about industrial polymers and their uses.  4. Learn about the processes of industrial polymer processing  5. Have knowledge about the processes of fragmentation and recycling of polymers | | | | | | | |
| **TEXTBOOK** | | | | | Ana Hatlarıyla Plastikler ve Katkı maddeleri, F.KAYA,2005 Birsen Yayınevi | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Handbook of Polymer Synthesis, H.R. Kricheldorf, O. Nuyken, G. Swift, 2nd Ed. Marcel Denkel, New York.2.Textbook of polymer science (Billmeyer) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, preliminary concepts Introduction to Plastics technology |
| 2 | The historical development and classification of polymers, daily and industrial polymers definition, |
| 3 | General properties of polymeric materials, monomers and synthesis; |
| 4 | Industrial polymers,  Thermoplastics (1): polyethylene, polypropylene, polystyrene, styrene copolymers |
| 5 | Thermoplastics (2): ionomers, acrylonitrile-butadiene-styrene, styrene-acrylonitrile |
| 6 | Midterm Examination 1 |
| 7 | Thermoplastics (3): The vinyl plastics: polyvinyl chloride, polyvinyl alcohol, polytetrafluoroethylene |
| 8 | Thermoplastics (4): acrylic polymers, cellulosic polymers, |
| 9 | Thermosets (1): phenolic resins, amino resins, polyesters, epoxy resins, polyurethanes, silicones, polycarbonates polyamides, polyimides ... |
| 10 | Thermosets (2): polyurethanes, silicones, polycarbonates polyamides, polyimides ... |
| 11 | Midterm Examination 2 |
| 12 | Engineering Plastics: Acetals, poliamidimidler, polycarbonates, polyketones |
| 13 | Polymer foam technology: PS, PU, PVC, PP, PE Foam |
| 14 | Plastic additives, Cleaning and recycling of polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402508 | **TITLE** | Inorganic Polymers |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Definition of inorganic polymers, the structures of inorganic polymers, classification of inorganic polymers according to various aspects, elastomeric inorganic polymers, metal containing polymers, inorganic polymers used as a catalyst, inorganic polymer having luminescence properties and application areas of inorganic polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Understanding the meaning and importance of inorganic polymers which holds an important place in our daily live. More closely to promote the world of inorganic polymer and manufacturing / machining processes to provide general information about the acquisition, some well-known properties of polymers and their applications to ensure that knowledge of the industry can adapt more easily to contribute to the training of personnel. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Recognize the inorganic polymers and provide information about application areas of inorganic polymers. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. The students will learn difference between organic and inorganic polymers  2. The students will understand what kind of materials are appropriate for polymerization  3. The students will learn 1-D, 2-D, 3-D polymeric structure  4. The students will learn metal-containing polymers  5. The students will have idea about application areas of inorganic polymers | | | | | | | |
| **TEXTBOOK** | | | | | James E. Mark, Harry R. Allcock, Robert West, Inorganic Polymers, Prentice Hall, 1992. | | | | | | | |
| **OTHER REFERENCES** | | | | | Ronald D. Archer, Inorganic and Organometallic Polymers, wiley–vch. 2001. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Definition of inorganic polymers, Special Characteristics of inorganic polymers, Modulus of Elasticity, Tensile Strength and Brittleness |
| 2 | Solubility, Glass Transition Temperature, Chrystallinity, Methods of characterization |
| 3 | Classification of inorganic polymers, History of inorganic polymers, Linear (Two-connective) polymers,polymeric sulphur, polymeric selenium,polymeric tellurium. |
| 4 | Linear polyphosphates(metaphosphates), alkali metal polyphosphates, polyphosphazenes, properties of polyphosphazenes |
| 5 | Polymeric sulphur nitride, polycarboranes, Three-connective network polymers, chalcogenide glasses, binary chalcogenide glasses, multicomponent chalcogenide glasses, |
| 6 | Midterm Examination 1 |
| 7 | Structure of multicomponentchalcogenide glasses, properties, glass transition temperatures, viscoelastic properties, electrical properties, Ultraphosphata glasses, |
| 8 | Preparation of Ultraphosphata glasses, glass transition temperatures, durability, melt viscosity, modulus, surface properties |
| 9 | Boron Nitride, Networks of mixed Three-and four-connectivity, Borate glasses, |
| 10 | Borate glasses, properties, expansion coefficient, Borophosphate glasses, |
| 11 | Midterm Examination 2 |
| 12 | Formation of Borophosphate glasses, structure, properties, glass transition temperature, durability, Melt viscosity, surface properties, |
| 13 | Metal-coordination polymers, inorganic polymer using as catalyst |
| 14 | Luminescence inorganic polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Okan Zafer YEŞİLEL **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402502 | **TITLE** | LİVİNG POLYMERİZATİON CHEMİSTRY |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction, general definitions, overview of condensation and addition polymerizations, living polymerization chemistry, living anionic polymerization, living cationic polymerization, living radical polymerization methods. Group transfer polymerization, atom transfer radical polymerization (ATRP or TMMRP), living oxyanionic polymerization, ROMP, NMRP, RAFT, CCTP. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course is to plan molecular weight and structure of polymer before polymer synthesis, and to teach narrow molecular weight distribution polymerization techniques. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To contribute individuals who have knowledge about living polymerization techniques | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Plan molecular weight and structure of polymer and make necessary calculations,  2. Perform narrow molecular weight distributed and controlled polymer synthesis,  3. Determine living polymerization tecnique appropriated to monomer,  4. Get an opportunity to apply living polymerization tecniques. | | | | | | | |
| **TEXTBOOK** | | | | | Handbook of Polymer Synthesis, H.R. Kricheldorf, O. Nuyken, G. Swift, 2nd Ed. Marcel Denkel, New York. 2005 Developments in Block Copolymer Science and Technology. Edited by IW Hamley, Wiley Press, UK, 2004. | | | | | | | |
| **OTHER REFERENCES** | | | | | lecture notes, projector. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, general definitions |
| 2 | Overview of condenzation polymerization |
| 3 | Overview of addition polymerization |
| 4 | Chemistry of living polymerization |
| 5 | Living anionic polymerization |
| 6 | Midterm Examination 1 |
| 7 | Living cationic polymerization |
| 8 | Living radical polymerization |
| 9 | Group transfer polymerization |
| 10 | Atom transfer radical polymerization (ATRP or TMMRP) |
| 11 | Midterm Examination 2 |
| 12 | Living oxyanionic polymerization |
| 13 | ROMP, NMRP |
| 14 | RAFT, CCTP |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Selma YARLIGAN UYSAL **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412604 | **TITLE** | Mechanical Properties of Macromolecules |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Fundamental concepts of elasticity theory, macromolecular models, equilibrium in rods and plates; rod deformation energy, plate equilibrium equation, mechanical analysis of deformed rods and plates, elasticity mechanisms in polymers, experimental molecular mechanics methodologies. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The main aim of the course is to investigate the mechanical properties of molecules by applying mechanical physics laws and methods to macromolecules and especially to polymers. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Understanding of mechanical properties of macromolecules by physical point of view. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Extensive understanding of mechanical concepts in molecular systems,  2. Investigation of mechanical interactions in molecules,  3. Ability to apply and associate interdisciplinary knowledge,  4. Ability to understand and solve natural sciences related problems,  5. Ability to analyze natural sciences related problems by using modern experimental setups and technology. | | | | | | | |
| **TEXTBOOK** | | | | | L. D. Landau and E. M. Lifshitsz (2002). Theory of Elasticity. Butterworth – Heinemann. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Doi, E., Edwards, S. F. (1999). The Theory of Polymer Dynamics. Oxford: Oxford University Pres. 2. Flory, P. J. (1969). Statistical Mechanics of Chain Molecules. New York: NY Wiley. 3. Boal, D. (2002). Mechanics of the Cell. New York: Cambridge Pres. 4. de Gennes, P-G. (1979). Scaling Concepts in Polymer Physics. Ithaca: Cornell University Press. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Fundamental concepts of elasticity theory |
| 2 | Stress and strain tensors, thermodynamics of deformation |
| 3 | Types of deformation |
| 4 | Macromolecular models |
| 5 | Macromolecular models |
| 6 | Midterm Examination 1 |
| 7 | Equilibrium in rods and plates; rod deformation energy, plate equilibrium equation |
| 8 | Equilibrium in rods and plates; mechanical analysis of deformed rods and plates |
| 9 | Elasticity mechanisms in polymers; longitudinal elasticity, bending |
| 10 | Elasticity mechanisms in polymers; bending, torsion, elasticity dynamics |
| 11 | Midterm Examination 2 |
| 12 | Experimental molecular mechanics methodologies |
| 13 | Experimental molecular mechanics methodologies |
| 14 | Experimental molecular mechanics methodologies |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Assoc. Prof. Sertaç Eroğlu **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412608 | **TITLE** | Membrane Technology |

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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 | | | | | 1 | | 20 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction and brief history of membrane technology, classification of membranes and separation process , membrane materials, polymer membranes, membrane production methods, mass transport and the design of the membrane systems; mass transport and design, driven process, transport trough the non-porous membranes, process design and membrane systems; microfiltration, ultrafiltration reverse osmosis, dialysis, electro-dialysis, pervaporation, gas separation, fouling and its amelioration, membrane equipment and process design, liquid membranes | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The importance of the membrane in the concentration and treatment process, Definition of membrane and membrane processes, membrane equipment and plant design, application of membrane processes | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Increased knowledge on Membrane system for polymer science and technology | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Understanding of the fundementals of the membrane sytem and membrans,  2. Understanding of the basic properties of the membrane used membrane applications and konowledge on the production methods  3. Analyzing of problems, experimental design and evaluation of the recevied data for membrane design,  4. To gain ability on research and learn scientific method | | | | | | | |
| **TEXTBOOK** | | | | | Lecturer notes | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Scott K., Hughes R., (1996) “Industrial Membrane Separation Technology” Blackie Academic& Professional, London 2. Ho, L., Sirkar, W. (Editors), Membrane Handbook, Chapman Hall Book Co., 1992. 3. Noble, R.D., Stern, S.A., Membrane Seperation Technology: Principles and Applications,Elsevier, 1995. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction and the history of membrane technology |
| 2 | Membrane materials, membrane preparation methods |
| 3 | Classification of membranes and separation process |
| 4 | Membrane configuration |
| 5 | Polymer and properties as membrane production |
| 6 | Midterm Examination 1 |
| 7 | Phase separation; transportation, propellant, transportation mechanism in porous and nonporous membranes |
| 8 | Microfiltration, ultrafiltration reverse osmosis |
| 9 | Dialysis, electro-dialysis, pervaporation, gas separation |
| 10 | Transport in membranes, polarization of concentration and membrane block |
| 11 | Midterm Examination 2 |
| 12 | Membrane equipment and process design |
| 13 | Liquid membranes |
| 14 | Application of membranes |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Haldun KURAMA **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401502 | **TITLE** | Methods in Polymer Synthesis |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction and definitions, nomenclature, classification, molar masses of polymers and characterization techniques, stepwise polymerization, radical polymerization of participation, anionic and cationic polymerization, living polymerization techniques. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To understand the meaning and importance of polymers that holds an important place in our daily live. To gain experience on the design, synthesis and characterization of polymeric materials.  Understanding the issues that should be considered in the areas of commercial application. To educate individuals about the methodology of synthesis of polymers with adequate facilities. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To provide the students having a good background on polymer chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Learn about a wide range of synthesis methods.  2. Choose the appropriate polymerisation method for any monomer  3. Understand the kinetics of both chain polymerization and step-growth polymerisations.  4. Makes a comparison between anionic and free radical polymerization,  5. Define and illustrate Zeigler-Natta and cationic polymerisations  6. distinguishes between bulk, solution and precipitation polymerizations | | | | | | | |
| **TEXTBOOK** | | | | | Polimer Kimyası (M. Saçak, Gazi yayınları) | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Handbook of Polymer Synthesis, H.R. Kricheldorf, O. Nuyken, G. Swift 2nd Ed. Marcel Denkel, New York, 2005. 2. Polymers: Chemistry and Physics of Modern Materials (J.M.G. Cowie), 2nd Ed. Stanley Thornes Inc. 1998, UK 3.Contemporary Polymer Chemistry, HR Allcock, FW Lampe,m JE Mark, 3rd Ed. Pearson Education Inc. USA, 2003 4.Principles of Polymerisation (Odian) 5.Polimer Teknolojisi (M. Saçak) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, preliminary concepts. Polymer nomenclature and classification |
| 2 | Molar masses of polymers and Polymer Characterization Methods |
| 3 | Stepwise polymerization: monomer types, and their polymer products, condensation reactions and kinetics, degree of polymerization and commercial applications |
| 4 | Free-radical addition polymerization (1): Initiators, chain reactions, inhibitors, retardants, initiator efficiency, the gel effect |
| 5 | The free-radical addition polymerization (2): Chain transfer, radical polymerization kinetics and determination of rate constants, comparison of step-growth polymerisation and addition polymerisations |
| 6 | Midterm Examination 1 |
| 7 | Ionic polymerization (1): The anionic polymerization, initiators, monomers, solvents, reaction mechanism and kinetics. |
| 8 | Ionic polymerization (2): The cationic polymerization, initiators, monomers, solvents, reaction mechanism and kinetics. |
| 9 | Living polymerization techniques: GTP, ATRP, RAFT, Oxyanionic polymerization |
| 10 | Characterization of polymers with different techniques. |
| 11 | Midterm Examination 2 |
| 12 | Living in the potential of polymer synthesis techniques, ionic polymerization commercial applications, |
| 13 | Recently featured polymerization techniques, ATRP and its application |
| 14 | GTP polymerization technique and application |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411607 | **TITLE** | Physical Chemistry of Macromolecules |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction, molecular weight and its distribution, configuration, conformation, free-radical polymerization and copolymerization kinetics, statistics of gradual polymerization, thermodynamics of polymerization, transitions in polymers, polymerization techniques, the size and shape of chain molecules, solubility parameter, thermodynamics of mixing: ideal solution, statistical thermodynamics of mixing, partial molar quantities, thermodynamics of dilute polymer solutions, vapor pressure, phase equilibrium, concentrated solutions and phase separation, chain configurations: the ideal and the actual coil molecules, viscometric size and intrinsic viscosity, dipole moments of chain molecules, determination of the number-average molecular weight: end group analysis, quantitative properties, osmotic pressure, determination of weight-average molecular weights and radius of gyration, relative methods for determination of molecular weights. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Take an important place in our daily lives the stages of synthesis of polymers understand in terms of kinetic and thermodynamic, to ensure that in-depth information on the synthesis and characterization of polymeric materials, with adequate facilities on the methodology of synthesis and structural characterizations of synthesized polymers, which can define the behavior of the solution to provide individuals grow up, cater to the needs of the industry as the most important equipment to ensure that individuals. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Ensures that the student has a solid infrastructure polymer chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students can query a wide range of synthesis methods and stages.  2. Students know the kinetics of polymerization, polymerization and resolution can analyze the thermodynamic point of view.  3. Students will have sufficient background that characterization of polymer solutions and interpretation of the behavior of polymers in solution  4. Students can structural characterization of polymers with modern equipment or students using traditional methods in the absence. | | | | | | | |
| **TEXTBOOK** | | | | | Polymers: Chemistry and Physics of Modern Materials (J.M.G. Cowie), 2nd Ed. Stanley Thornes Inc.1998, UK | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Handbook of Polymer Synthesis, H.R. Kricheldorf, O. Nuyken, G. Swift, Marcel Denkel, New York, 2005. 2. Contemporary Polymer Chemistry, HR Allcock, FW Lampe,m JE Mark, 3rd Ed. Pearson Edu. Inc. USA, 2003 3. Principles of Polymerisation (Odian) 4. Polimer Kimyası, M. Saçak, TR 5. Physical Chemistry, Atkins Physical Organik Chemistry, N. Isaacs, Pearson Education Inc. Pres, 1995, UK | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, molecular weight and its distribution, configuration, conformation |
| 2 | Kinetics and statistics of gradual polymerization |
| 3 | Free-radical polymerization and copolymerization kinetics, |
| 4 | Thermodynamics of polymerization, transitions in polymers |
| 5 | Polymerization techniques, the size and shape of chain molecules |
| 6 | Midterm Examination 1 |
| 7 | Solubility parameter, thermodynamics of mixing: ideal solution |
| 8 | Partial molar quantities, statistical thermodynamics of mixing |
| 9 | Thermodynamics of dilute polymer solutions, |
| 10 | Vapor pressure, phase equilibrium, concentrated solutions and phase separation |
| 11 | Midterm Examination 2 |
| 12 | Chain configurations: the ideal and the actual coil molecules, viscometric size and intrinsic viscosity, dipole moments of chain molecules |
| 13 | Determination of the number-average molecular weight: end group analysis, quantitative properties, osmotic pressure, determination of weight-average molecular weights and radius of gyration |
| 14 | Determination of the number-average molecular weight: end group analysis, quantitative properties, osmotic pressure, determination of weight-average molecular weights and radius of gyration, Relative methods for determination of molecular weights |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bü **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411603 | **TITLE** | Physical Chemistry of Polymer Solutions |

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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 | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Molecular weight in polymer chains, conformations and configurations of chain molecules , Thermodynamics of macromolecules solutions, phase equilibria of polymer systems , partial molar propertites of soluted macromolecules | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of this course the students should be able to: (i) appreciate the importance and calculations of molecular weights of polymer chains, (ii) understand and interprete conformations and configurations of chain molecules (iii) recognize the thermodynamic properties of macromolecular solutions (iv) learn phase equilibria of polymeric systems , (vi) describe partial molar properties of macromolecules in solution. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Provide that the student has a solid infrastructure polymer chemistry. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Get a basic background on physicochemical properties of polymer solutions,  2. Appreciate the importance and calculations of molecular weights of polymer chains,  3. Understand and interprete conformations and configurations of chain molecules,  4. Recognize the thermodynamic properties of macromolecular solutions. | | | | | | | |
| **TEXTBOOK** | | | | | 1.Polymer Solutions (I. Teraoka, Brooklyn,NY) 2.Polimer Kimyası (M. Saçak, Gazi Yayınları) | | | | | | | |
| **OTHER REFERENCES** | | | | | Textbook of Polymer Science (Billmeyer) Polymers:Chemistry and Physics of Modern Materials (JMG Cowie, UK-1991) Principles of Polymerisation (Odian) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, nomenclature and classification of polymers |
| 2 | Molecular weights of polymer chains and characterisation techniques |
| 3 | Conformation and configuration in polymers |
| 4 | Conformation and configuration in polymers |
| 5 | Thermodynamics of macromolecular solutions |
| 6 | Midterm Examination 1 |
| 7 | Thermodynamics of macromolecular solutions |
| 8 | Thermodynamics of macromolecular solutions |
| 9 | Thermodynamics of macromolecular solutions |
| 10 | Phase equibria in polymeric systems |
| 11 | Midterm Examination 2 |
| 12 | Phase equibria in polymeric systems |
| 13 | Phase equibria in polymeric systems |
| 14 | Partial molar properties of macromolecules in solution |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Assoc. Prof. Dr. Necmettin Caner **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411604 | **TITLE** | Physics of Macromolecules |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Statistical mechanical concepts, thermodynamic concepts and energy in molecular level, colloidal and polymeric structures, single polymer chain, ideal polymer chains and models, real polymeric chains, restricted polymer chains, statistical properties of polymers, Brownian motion and diffusion in polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The main aim of the course is to explore and understand macromolecular systems at molecular level, and the events occurring in those systems by using physical concepts. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Understanding of macromolecular properties by physical point of view. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Understanding of physics related concepts in the molecular world,  2. Investigation of physical properties of colloids and polymers  3. Ability to apply and associate interdisciplinary knowledge,  4. Ability to understand and solve natural sciences related problems,  5. Ability to work interdisciplinary, | | | | | | | |
| **TEXTBOOK** | | | | | de Gennes, P-G. (1979). Scaling Concepts in Polymer Physics. Ithaca: Cornell University Press. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Doi, E., Edwards, S. F. (1999). The Theory of Polymer Dynamics. Oxford: Oxford University Pres. 2. Rubenistein M., Colby R.H. (2004). Polymer Physics. Oxford: Oxford University Pres. 3. Berg, H. C. (1993). Random Walks in Biology. New Jersey: Princeton University Pres. 4. Alberts B., et.al. (2002). Molecular Biology of the Cell. Garland Science. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Statistical mechanical concepts in molecular level |
| 2 | Thermodynamic concepts and energy in molecular level |
| 3 | Introduction to colloidal and polymeric structures |
| 4 | Single polymer chain |
| 5 | Single polymer chain |
| 6 | Midterm Examination 1 |
| 7 | Ideal polymer chains and models |
| 8 | Ideal polymer chains and models |
| 9 | Real polymeric chains |
| 10 | Restricted polymer chains |
| 11 | Midterm Examination 2 |
| 12 | Statistical properties of polymers |
| 13 | Statistical properties of polymers |
| 14 | Brownian motion and diffusion in polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Asst.Prof. Dr. Sertaç Eroğlu **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411608 | **TITLE** | Polymer Composites |

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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 (√)]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 20 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction to composite materials, the advantages of composite materials, composite components: matrix and reinforcements, common production methods of polymer composites, the properties of polymer composites (morphologic, thermal, mechanic etc.), the applications of polymer composites. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Providing the students to gain thorough knowledge about the components of composite materials, the properties of polymer composites and the methods determining these properties, the applications of polymer composites and the technological developments at those applications. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will be able to understand the importance of polymer composites among the other material technologies, learn the production methods and the scientific studies at this subject, improve the written and oral communication skills by doing and presenting the homework, in addition to these; they will be able to understand the importance of life-long learning and get application skills. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students recognize the composite materials, entitle the components of composites, classify the components to sub classes and explain them.  2. Students say the differences/similarities of polymer composites with the polymers.  3.Students describe the production methods of polymer composites and explain the properties.  4. Students examine and evaluate the applications of composites.  5. Student examines, describes and chooses while preparing the homework, defends and evaluates while presenting it. | | | | | | | |
| **TEXTBOOK** | | | | | 1. Şahin, Y.,“Kompozit Malzemelere Giriş”, Seçkin Yay.San.veTic.AŞ, 2006 2. Kelly, A. and Zweben, C., “Comprehensive Composite Materials”, Amsterdam: Elsevier, 2000. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Matthews F.L. and Rawlings R.D., “Composite Materials: Engineering and Science”, CRC Press, 1999 2. Mai Y.W. and Yu Z.Z., “Polymer nanocomposites”,Woodhead Pub.,2006. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Composite Materials |
| 2 | The components of composites: matrix and reinforcements |
| 3 | Important polymer composites |
| 4 | The production methods of thermoplastic polymer composites |
| 5 | The production methods of thermoset polymer composites |
| 6 | Midterm Examination 1 |
| 7 | The properties of polymer composites |
| 8 | The interactions of composite components and the effect of it to the properties |
| 9 | The determination of polymer composite properties |
| 10 | The applications of polymer composites |
| 11 | Midterm Examination 2 |
| 12 | The applications of polymer composites and the advantages of them |
| 13 | Polymer composites at nanocomposite technology |
| 14 | Homework presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Dr. Demet Topaloğlu Yazıcı **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401503 | **TITLE** | Polymer Engineering |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Polymer engineering used repetition of principles: Heat transfer, momentum transfer, deformation, rheological equations. Plastic processing mixtures, varieties. Plastics industry used of the test methods, rheometers, optical methods, birefringence. Blow molding, extrusion whit foaming, injection foam. Bonding methods, heat sealing, sealing whit dielectric methods, principles and methods. The engineering principles application to analysis and design in polymerization processes. Mathematical modeling of polymerization kinetics, ideal polymerization reactors, heat and mass transfer, reactor dynamics and optimization, interference effects, examination of important industrial processes. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Ensure that the learning of basic concepts about polymers, polymerization process modeling, ensure that the creation of kinetic models and acquisition of knowledge about the application. The polymerization process learn of heat and momentum transfer. Synthetic structures that are being used in the industry sector in recognition of the need for and provision of training to overcome the elements. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Live information about the individuals who contribute to the growth polymerization techniques. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Synthetic polymers learn  2. Learn about the importance inindustry of synthetic polymers,  3. Learn the usage of synthetic polymers,  4. Modeling of polymerization processes,  5. Desing Models can setting up on the energy and mass balances,  6. To achieve higher efficiency and quality product designs will begin to | | | | | | | |
| **TEXTBOOK** | | | | | 1. Polimerler I (E. Pişkin)2. Mühendislik Polimerleri (E. Pişkin) | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Fundamentals of Polymer Engineering (A. Ram)2. Polymer Process Engineering (Richard G. Griskey) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Polymer engineering used repetition of principles: Heat transfer, momentum transfer, deformation, rheological equations. |
| 2 | Polymer engineering used repetition of principles: Heat transfer, momentum transfer, deformation, rheological equations. |
| 3 | Plastic processing mixtures, varieties. |
| 4 | Plastics industry used of the test methods, rheometers, optical methods, birefringence. |
| 5 | Blow molding, extrusion whit foaming, injection foam. |
| 6 | Midterm Examination 1 |
| 7 | Bonding methods, heat sealing, sealing whit dielectric methods, |
| 8 | Bonding methods, heat sealing, sealing whit dielectric methods, principles and methods. |
| 9 | The engineering principles application to analysis and design in polymerization processes. |
| 10 | The engineering principles application to analysis and design in polymerization processes. |
| 11 | Midterm Examination 2 |
| 12 | Mathematical modeling of polymerization kinetics, ideal polymerization reactors, heat and mass transfer, |
| 13 | Mathematical modeling of polymerization kinetics, reactor dynamics and optimization |
| 14 | Mathematical modeling of polymerization kinetics,interference effects, examination of important industrial processes. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Selma YARLIGAN UYSAL **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412606 | **TITLE** | Polymer Gels and Network Structures |

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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 (√)]** | | | | | | |
| 0 | |  | | | | 0 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 30 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Definition of gels, synthesis of gels, mikrogels, statistical theories of gelation, free-radical chain mechanism and kinetics of gel formation, moments of method and molecular weight distributions of gelation process, sol-gel phase transitions, rubber elasticity theory, stress-relaxation curves, thermodynamic relations for polymer solutions, dilute polymer solutions, phase equilibria in polymer systems, polymer gel inflatables, equilibrium swelling of ionic gels, hydrogels, critical phenomena, collapse of gels and phase transitions, chemical modification of gels, practice areas of gels, current problems. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | General information about the gel-forming polymer-based materials important materials of our daily lives and the students provide information an in-depth characterization and synthesis of gel-forming polymers. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students aims gain a solid infrastructure of polymer chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Network structure polymers and their importance apprehend.  2. Gel-forming polymers and understand the role and importance in everyday  3. Gel forming knows the concept of polymeric material  4. Network structure synththesis of polymers and have knowledge about properties | | | | | | | |
| **TEXTBOOK** | | | | | Handbook of Polymer Synthesis, H.R. Kricheldorf, O. Nuyken, G. Swift, 2nd Ed. Marcel Denkel, New York, 2005. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Contemporary Polymer Chemistry, HR Allcock, FW Lampe,m JE Mark, 3rd Ed. Pearson Education Inc. USA, 2003 2. Polymer chemistry, M. Saçak, TR | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, pre-concepts, the definition of gels |
| 2 | Statistical theories of gelation |
| 3 | Methods synthesis of gels |
| 4 | Free-radical chain mechanism and kinetics of gel formation |
| 5 | Moments of method and molecular weight distributions of gelation process, sol-gel phase transitions |
| 6 | Midterm Examination 1 |
| 7 | Sol-gel phase transitions, Rubber elasticity theory |
| 8 | Stress-relaxation curves, Thermodynamic relations for polymer solutions |
| 9 | Dilute polymer solutions, Phase equilibria in polymer systems |
| 10 | Polymer gel inflatables, Equilibrium swelling of ionic gels |
| 11 | Midterm Examination 2 |
| 12 | Hydrogels, Critical phenomena, Collapse of gels and phase transitions |
| 13 | Chemical modification of gels, Practice areas of gels, current problems |
| 14 | Microgels |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Haldun Kurama **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411605 | **TITLE** | Polymer Photochemistry |

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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 | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Light effect, exiplex, excimer formation, quantum yield, photoinitiators, mechanism of photoinitiated free radical polymerisation, photochemical cationic polymerisation , salts in photochemical cationic polymerisation , photochemical condensation polymerisation, graft copolymer synthesis by photochemical polymerisation, chemistry of photoresists. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of this course the students should be able to: (i) learn the basic concepts in photochemistry, (ii) understand the usage of photoinitiators in polymerization, (iii) recognize the basic principles of photochemically synthesization of free radical and cationic polymerization, (iv) learn the usage of photochemistry in condensation polymerization and copolymer synthesis, (v) describe photoresists. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will have the ability to interpret the industrial area will need. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Learn the basic concepts in photochemistry,  2. Understand the usage of photoinitiators in polymerization,  3. Recognize the basic principles of photochemically synthesization of free radical and cationic polymerization,  4. Learn the usage of photochemistry in condensation polymerization and copolymer synthesis | | | | | | | |
| **TEXTBOOK** | | | | | 1. Allen, N.S. (2010). Photochemistry and Photophysics of Polymeric Materials.UK: Wiley2. Wardle ,B. (2009). Principles and Applications of Photochemistry.Hoboken, N.J. : Wiley | | | | | | | |
| **OTHER REFERENCES** | | | | | Textbook of Polymer Science (Billmeyer)Polymers:Chemistry and Physics of Modern Materials (JMG Cowie, UK-1991) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction and definitions |
| 2 | Photoinitiators and their types |
| 3 | Photoinitiated free radical polymerisation |
| 4 | Photochemical cationic polymerisation |
| 5 | Salts in photochemical cationic polymerisation |
| 6 | Midterm Examination 1 |
| 7 | Photochemical polymerisation and onium salts |
| 8 | Photochemical condensation polymerisation |
| 9 | Photochemical condensation polymerisation |
| 10 | Photochemical copolymer synthesis |
| 11 | Midterm Examination 2 |
| 12 | Photochemical copolymer synthesis |
| 13 | Graft copolymer synthesis by photochemical polymerisation |
| 14 | Photochemical block copolymer synthesis, photoresists |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Assoc. Prof. Dr. Necmettin Caner **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401505 | **TITLE** | Polymer Processing |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 50 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Thermoplastic, introduction of thermosets and elastomers, plastics design, general classification of polymer processing methods, introduction of machinery used in extrusion forming operations, examination of extrusion lines one by one, which are important characteristics of polymer extrusion, Examination of current theories of extrusion, extruder operating principle, problems, injection molding and theories, blowing molding, rotate the molding process, the molding process by pouring, the process of creating foam, compression molding, thermoforming and other operations. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Students in our lives introduction of polymeric materials with a wide range of usage, principles and methods of production and processing gain. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | |  | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students polymers forming, extrusion, and the current theories and principle of operation in this field will be studied, also have information about other processing methods. For example, injection molding blowing molding, rotating molding, pouring molding, foam generation process, compression molding | | | | | | | |
| **TEXTBOOK** | | | | | 1. Erhan Piskin, Plimer Teknolojisine Giriş, Ankara, offset, Istanbul 19872. Han E. H. Meijer, Processing of Polymers, 1997 | | | | | | | |
| **OTHER REFERENCES** | | | | | Tim A. Osswald, Polymer processing fundamentals, 1998M. Lazar, T. Blaha, J. Rychly, Chemical Reactions of Natural and Synthetic Polymers, Ellis Horwood Limited publishers, UK, 1989. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Thermoplastic, introduction of thermosets and elastomers |
| 2 | Plastics design |
| 3 | General classification of polymer processing methods |
| 4 | Introduction of machinery used in extrusion forming operations |
| 5 | Examination of extrusion lines one by one |
| 6 | Midterm Examination 1 |
| 7 | Which are important characteristics of polymer extrusion |
| 8 | Examination of current theories of extrusion, |
| 9 | Extruder operating principle, problems |
| 10 | Injection molding and theories |
| 11 | Midterm Examination 2 |
| 12 | Blowing molding, rotate the molding process  The molding process by pouring, the process of creating foam |
| 13 | Compression molding |
| 14 | Thermoforming and other operations. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Assist. Prof. Dr. Macit NURBAŞ **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402505 | **TITLE** | Polymer Recycling Technologies |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The origin and classification of polymer waste, Applied processes as in the evaluation of energy and petrochemical raw materials of polymer waste (pyrolysis gasification, hydrolysis, hydrogenation, liquidation, biological methods), Bio-polymers, methods of chemical conversion of PET  (glycolysis, methanolysis, hydrolysis, hybrid processes, the production of polyol), Recycling of polyolefins, recycling of PVC, recycling of polystyrene, nylon, polyurethane, recycled car tires, the use of polymer waste in activated charcoal manufacture. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | This course gives information about the origin of polymer waste, and this waste is classified and evaluated as a source of energy and petrochemical raw materials are discussed under the applied different methods. In addition, according to the physical properties, chemical structure and area of use of the obtained products, how the evaluated are discussed. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To contribute to the growth of conscious individuals and effective use of national resources for the recycling and use of plastic. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Able to define and classify the origin of some of the polymers.  2. Polymer to serve as raw material waste energy and petrochemical facilities and processes can be applied for this purpose to define.  3. Polymer waste recycling polymer waste in relation to the processes applied to the evaluation of actual stages of product with simple flow charts to explain.  4. Defining the physical and chemical changes in the flow diagrams.  5. The evaluation of the energy and petrochemical wastes as raw materials in the polymer, the world 'and in Turkey to make comments about the actions being performed | | | | | | | |
| **TEXTBOOK** | | | | |  | | | | | | | |
| **OTHER REFERENCES** | | | | | Recycling Handbuch (Strategien-Techn-Produkte). Werner Nickel,VDI Verlag, 19962. Plastic, Rubber and Paper Recycling, Charles P. Rader ACS Symposium Series 609, 1995 3. Polymer Recycling, John Scheirs, 1997 4. Frontiers in Science and Technology of Polymer Recycling, NATO-ASI Series, Vol.351, Series:E | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, definitions |
| 2 | The origin and classification of polymer waste, |
| 3 | Applied processes as in the evaluation of energy and petrochemical raw materials of polymer waste: (1) pyrolysis gasification, |
| 4 | Applied processes as in the evaluation of energy and petrochemical raw materials of polymer waste: (2) hydrolysis, hydrogenation, |
| 5 | Applied processes as in the evaluation of energy and petrochemical raw materials of polymer waste: (3) liquidation, biological methods, |
| 6 | Midterm Examination 1 |
| 7 | Bio-polymers, methods of chemical conversion of PET  glycolysis, methanolysis, |
| 8 | Bio-polymers, methods of chemical conversion of PET  hydrolysis, hybrid processes, the production of polyol |
| 9 | Recycling of polyolefins, |
| 10 | Recycling of PVC |
| 11 | Midterm Examination 2 |
| 12 | Recycling of polystyrene |
| 13 | Nylon, polyurethane, recycled car tires, |
| 14 | The use of polymer waste in activated charcoal manufacture. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Muammer Kaya **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401504 | **TITLE** | Polymer Rhelogy |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 20 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The basic concepts of rheology (the bases of flow behavior, measurement methods, mathematical modeling of rheologic behavior), examples of polymer systems, rheometry and material functions, generalized Newton Law models, linear and non-linear viscoelastic models, the rheologic behaviors of polymer liquids in polymer production (the characterization of fluid, industrial rheometers), practical applications of rheology in polymer industry. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Providing the students to gain thorough knowledge about the basis of rheology, rheometry and measurement methods, examining the rheologic behaviors of polymers and mathematical modeling and the applications of polymer rheology. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will be able to learn the science of rheology and the necessities to apply it to the real systems, explain the flow behavior of polymer included systems and improve the written and oral communication skills by doing and presenting the homework. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Explains the rheology concept, says the differences/similarities of flow behaviors,  2. Explains the rheologic properties of polymers, says the measurement methods,  3. Explains the flow models of non-Newtonian fluids,  4. Examines and evaluates the mathemathical modeling of a system used in polymer rheology. | | | | | | | |
| **TEXTBOOK** | | | | | Bird, R. B., Stewart, W. E., and Lightfoot, E. N., “Transport Phenomena”, 2nd edition, John Wiley, New York, 2002. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Shenoy, A.V.,“Rheology of filled polymer systems”,Knovel corp., 1999.2. Gupta, R.K., “Polymer and composite rheology”, Marcel Dekker, 2000. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | The basic concepts of rheology |
| 2 | Mathematical modeling of rheologic behavior |
| 3 | Mathematical modeling of rheologic behavior |
| 4 | Examples of the polymer systems |
| 5 | Rheometry and material functions |
| 6 | Midterm Examination 1 |
| 7 | Generalized Newton Law models |
| 8 | Linear and non-linear viscoelastic models |
| 9 | The rheologic behaviors of polymer fluids in polymer production (the characterization of fluid) |
| 10 | The rheologic behaviors of polymer fluids in polymer production (industrial rheometers) |
| 11 | Midterm Examination 2 |
| 12 | Practical applications of rheology in polymer industry |
| 13 | Practical applications of rheology in polymer industry |
| 14 | Homework presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Assist Prof. Dr. Demet Topaloğlu Yazıcı **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505401506 | **TITLE** | Polymers in Corrosion Control |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 30 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Corrosion definition, electrochemical and thermodynamic aspect, methods for corrosionmeasurements and inhibition, corrosion inhibition by surface coating, preparation of metalsurface, application methods, metallic coating, polymeric coating, physical vapor deposition,electroactive organic polymers, recent applications, some test methods | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course is;  1. To give sufficient knowledge and skill about the usage of polymericic materials in corrosion control  2. To contribute positive effects in the needs in this area | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Responds to the needs of trained persons in the subject of solving corrosion problems of the industry. Educate these persons in the subject of polymeric coating which is one ofthe corrosion control method | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. To have idea about definition importance and economic aspects of corrosion and also electrochemistry and thermodynamicof corrosion  2. Revise corrosion principles corrosion prevention and control engineering methods  3.Learning corrosion monitoring and test methods  4. Examining protective polymer coatings and polymeric inhibitors | | | | | | | |
| **TEXTBOOK** | | | | | Van, O. (2004). Corrosion Control of Metals by Organic Coatings. UK: CRC | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Zarras, P. & Stenger-Smith, J.D. & Wei, Y. (2003). Electroactive Polymers forCorrosion Control. Washington, DC: Am Chem Soc.2. Wicks, Z.W. & Jones, F. & Pappas, S.P. (1999). Org Coatings (2nd ed).New York: Wiley.3. Licari, J. J. & Hughes, L. A. (1990). Handbook of Polymer Coatings for4. Electronics – Chemistry, Technology and Applications (2nd ed). Park Ridge, N.J. Noyes Publications.5. Sherier, L. L. & Jarman, R. A. & Burstein, G. T. (1994). Corrosion (3rd ed). Oxford: Butterworth – Heinemann Ltd. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Definition of Corrosion and Electrochemical Nature of Corrosion |
| 2 | Electrochemical Kinetic Approach es in Corrosion |
| 3 | Corrosion Rate Measurment Techniques |
| 4 | Principles and Clasification of Corrosion Protection Techniques |
| 5 | Principles of usin Polymers as Corrosion Inhibitors |
| 6 | Midterm Examination 1 |
| 7 | Usage of water soluble and nonionic polymers as corrosion inhibitors |
| 8 | Principles of Corrosion Protection by Coating |
| 9 | Surface Preparation Metods of Metals for Coating Process |
| 10 | Coating of Metal Surface by polymers by Deep Coating and Spin Coating Methods |
| 11 | Midterm Examination 2 |
| 12 | Coating Metal Surfaces by Nonconducting polymers using Electrochemical Methods |
| 13 | Coating Metal Surfaces By Conducting Polymers using Electrochemical Methods |
| 14 | Recent Advances in Polymer Coatings, Test Methods Related with the Protection Perfomance of Polymer Coatings |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Gözen Bereket **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505402504 | **TITLE** | Stability and Degradation of Polymers |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 50 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | 1. Introduction and general information. Durability of polymers, biodegradable polymers, polymers, recovery, and basic concepts.  2. Based on analysis techniques use to study for mechanisms of degradation of polymers.  3. Thermal degradation, oxidation, photo-degradation mechanisms. Antioxidants and stabilizers.  4. Degradation mechanisms of connections with the danger of fire.  5. Causes and mechanisms of degradation of polymer material is exposed to working conditions, biodegradability and mechanical degradation mechanisms of polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Students, use of polymeric materials that have wide application area in our lives and provide us with information about the production techniques also be gained during and after the production of this polymer decomposition methods to teach about the property and stability. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | |  | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Durability at polymers recovery and degradability and degradation of polymers will have knowledge about their mechanisms. | | | | | | | |
| **TEXTBOOK** | | | | | Krzysztof Pielichowski, James Njuguna, Thermal degradation of polymeric materials, 2005 | | | | | | | |
| **OTHER REFERENCES** | | | | | lecture notes, projector. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction and general information. |
| 2 | Basic concepts about the durability of polymers. |
| 3 | Basic concepts about recycling of polymers. |
| 4 | Basic concepts of biodegradable polymers. |
| 5 | Based on analysis techniques use to study for mechanisms of degradation of polymers. |
| 6 | Midterm Examination 1 |
| 7 | Thermal degradation, oxidation mechanisms of polymers. |
| 8 | Photo-degradation mechanisms of polymers. |
| 9 | Antioxidants and stabilizers. |
| 10 | Degradation mechanisms of connections with the danger of fire. |
| 11 | Midterm Examination 2 |
| 12 | Causes of degradation of polymer material is exposed to working conditions.  Polymer material is exposed to working conditions, degradation mechanisms. |
| 13 | Biodegradability polymers. |
| 14 | Biodegradability and mechanical degradation mechanisms of polymers. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. |  |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. |  |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. |  |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process |  |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. |  |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field |  |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. |  |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. |  |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. |  |  |  |

**Prepared by:** Prof. Dr. Selma YARLIGAN UYSAL **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412605 | **TITLE** | Synthesis of Nanoparticles |

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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 | |  | | | | x | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 30 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | New methods for the synthesis of nano-particles. Polymer nanoparticle technology. Latex technology (emulsion, suspension and emulsion polymerizations). cross-linked nano-structured polymers, nanojeller microgel, SCL micelles, polymer nanocomposites, nano-catalysts, nano-porous materials, the other nanomaterials synthesis and characterization | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Nano-sized polymer materials design, synthesis and characterization of acquisition provision of in-depth information. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students aims gain a solid infrastructure of polymer chemistry. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. The concept of nanoparticle technology Understand.  2. Nanoparticle synthesis methods obtain knowledge.  3. Nanoparticle synthesis methods obtain experience.  4. Size due to changes notice amenities and losses in the application | | | | | | | |
| **TEXTBOOK** | | | | | Nanomaterials: From Research to Appl., 2006, H.Sonoko ve ark,. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Materials Science and Engineering Handbook, 3rd Ed., JF Shackelford, W Alexander, CRC Press, USA 20012. Nanomaterials and Nanochemistry, 2006, C. Br´echignac P. Houdy M. Lahmani, Berlin, France. 3. Emulsions: Teory and prectice, P. Becher, 2001, US, Oxford Press Controlled Synthesis of Nanoparticles in Microheterogeneous Syst. 2006-Springer, V. T. Liveri4. Metal nanoparticles: Synthesis, Chr. and Appl., 2002, D.L. Feldheim and G.A. Foss, USA, NY.5. Emissive Materials.Nanomaterials, 2006, A. Abe ve arkadaşları6. Polymer nanocomposites, 2006, Edited by Yiu-Wing Mai and Zhong-Zhen Yu. Published by Woodhead Publishing Limited, Abington Hall, Abington,Cambridge CB1 6AH, England | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Nanoscience and pre-concepts |
| 2 | Classification of nanostructures and material property-structure interaction |
| 3 | New methods for the synthesis of nanoparticles. |
| 4 | Polymer nanoparticle technology |
| 5 | Latex technology: emulsion polymerization with a latex |
| 6 | Midterm Examination 1 |
| 7 | Latex technology: Dispersion Polymerization |
| 8 | Latex technology: Suspension Polymerization |
| 9 | Cross-linked nano-structured polymers, SCL micelles and synthesis |
| 10 | Nanojeller, the synthesis of microgel |
| 11 | Midterm Examination 2 |
| 12 | Synthesis of metal oxide nano-structures |
| 13 | Containing polymer nanocomposites |
| 14 | Nano-catalysts, nano-porous materials, synthesis and characterization of other nanomaterials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

|  |  |  |  |
| --- | --- | --- | --- |
| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412607 | **TITLE** | Water Soluble and Swellable Polymers |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | General description of polymers, some water-soluble polymers, polymer-solvent relationship, dissolving and precipitation behavior, solution-viscosity behavior, classification of water-soluble polymers, neutral polymers, anionic polymers, cationic polymers, betaine polymers, zwitterionic polymers, amphoteric, synthesis of water-soluble and swellable polymers, application areas, solution behavior, self-assembly, the creation of nano-structures presentation of the current importance of biopolymers, hydrogel, microgel and cross-linked polymer-based systems. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Water-soluble polymers and their properties (solution behavior) on the build infrastructure.Understand the importance of water-soluble polymers in daily life. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To get information about investigations frequently used in the synthesis of water-soluble and swellable polymers and their applications | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students can distinguish a wide range of types of water-soluble polymer,  2. Students can define the behavior of the solution,  3. Students can knowledge about the behavior of the solution,  4. Students learn concepts of microgel and hydrogels. | | | | | | | |
| **TEXTBOOK** | | | | | Water Soluble Polymers, Solution Properties and Applications, Z. Amjad, Kluwer Academic Pub. 2002, USA | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Water Soluble Polymer Applications in Foods, A. Nussinovitch, Blackwell Science Pub. 2003, UK2. Water-soluble synthetic polymers: Properties and behavior (P. Molyneux) CRC Handbook of Thermodynamic Data of Aqueous Polymer Solutions, C. Wohlfarth, CRC Press, USA, 20043. Water soluble polymers in Encyclopedia of Polymer Science and Technology. John Wiley and Sons Inc. Page 452 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | General description of polymers |
| 2 | Water and the solution concept, dissolution and precipitation behavior |
| 3 | Solution-viscosity behavior |
| 4 | Classification of water-soluble polymers |
| 5 | Some water-soluble polymers and commercial applications |
| 6 | Midterm Examination 1 |
| 7 | Neutral polymers: anionic polymers, cationic polymers |
| 8 | Betaine polymers, zwitterionic polymers |
| 9 | Amphoteric, solution behavior |
| 10 | Self-assembly, the creation of nano-structures |
| 11 | Midterm Examination 2 |
| 12 | Cross-linked polymer-based systems |
| 13 | Microgels |
| 14 | Hydrogels, Applications of water-soluble and swellable polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505412601 | **TITLE** | Functional Polymers and Modifications |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The new design and polymerization of monomers, polymer-assisted chemical reactions, polymer bound metal catalysts, phase transfer catalysts, affinity chromatography, enzyme immobilization, selective ion transport solar energy applications and Functional Polymers. Polymer modification methodsKinetics and mechanism of polymer modification industrial engineering such as PVC, polystyrene, cellulose polymers. Modified polymer properties and applications. Surface modification methods. Characterization of the modified polymers | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Basic concepts related to functional polymers, polymer modification reactions to reveal the structural effects, modification methods, characterization and application of information about the areas, and industry growth and the needs of individuals with adequate facilities to ensure responsivity. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Ensures that the student has a solid infrastructure polymer chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. defines the basic concepts of Functional polymers.  2. knowledge about the modification of polymers reactions.  3.Estimate the impact on the structural properties of the polymer modification reaction.  4. information about the Modification methods and characterization,  5. Learns the location in industry of modified polymers | | | | | | | |
| **TEXTBOOK** | | | | | Electrochromism: Fundamental and Applications. Paul M. S. Monk, Roger J. Mortimer, David R. Rosseinsky.Verlagsgesellschaft. 1995. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. A.Ravve, Principles of Polym Chem, 2. ed. (2000) Kluwer Acad. Publishers., 2. A.O.Patil, D.N.Schulz, B.M.Novak, Functional Polymers: Modern Synthetic Methods and Novel Structures, ACS Publications, ACS Symposium Series 704, 1997-USA. 3. K.Takemoto, R.M.Ottenbrite, M.Kamachi, Functional Polymers and Monomers, 2. ed. (1997) Marcel Dekker. 4. Warshawsky A, Synthesis and Separations Using Functional Polymers, (1991) John Wiley &Sons.E.Tsuchida 5. M. Lazar, T. Blaha, J. Rychly, Chemical Reactions of Natural and Synthetic Polymers, Ellis Horwood Limited publishers, UK, 1989. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, pre-concepts, macromolecules characteristic properties of chemical reactions; effect of visinal groups, media effect, chains interaction |
| 2 | The new design and polymerization of monomers |
| 3 | Polymer-assisted chemical reactions, polymer bound metal catalysts, phase transfer catalysts |
| 4 | Affinity chromatography, enzyme immobilization |
| 5 | Selective ion transport solar energy applications and functional Polymers |
| 6 | Midterm Examination 1 |
| 7 | Structural unit modification in polymers chains; hydrocarbon polymers, polymers reactions the heteroatom |
| 8 | Branching of macromolecule, branching polymers and graft copolymers  Bonding of macromolecule and cross bonding; cross bonding types, cross bonding methods, the last groups reactions |
| 9 | Substitution reactions of the polymer chairs, macromolecules degradation reactions; feat, light burning, oxidation, degradation with ozone, ionic degradation, radiolitic degradation, biodegradation |
| 10 | New type properties of modified polymers; transformation reactions, solubility, transmittance, surface properties, mechanic properties and electrical properties |
| 11 | Midterm Examination 2 |
| 12 | Polymer modification methods Kinetics and mechanism of polymer modification industrial engineering such as PVC, polystyrene, cellulose polymers |
| 13 | Surface modification methods. Characterization of the modified polymers |
| 14 | Modified polymer properties and applications; modified polymers, semipermeable membrane, polymers is grafted by functional groups, modeling of biopolymer functions |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411601 | **TITLE** | Synthesis and Characterization of Macromolecules |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Condensation and addition polymerization, mass, solution, suspension, emulsion, inverse emulsion, mikroemülsion, interfacial polymerization methods, methods and practices for the design of new polymeric products, block and graft copolymers, synthesis methods, polymer gels and structure-property connections, polymer modification, determination of the physical properties of the polymer material, structure determination of unknown polymer material thermal (DSC), gel permeation chromatography (GPC), spectroscopic (UV-VIS, IR, NMR) analysis techniques. Viscometry, osmometri measurement methods, experimental work shall be done on issues such as the processing of polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Polymerization learning methods providing, gain knowledge in designing new polymer products providing, information about the physical properties of polymeric materials, physical and chemical properties of the polymer material in any variety of ways of finding people to catch up with the provision of adequate facilities for. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Provide that the student has a solid infrastructure polymer chemistry. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Recognize methods of polymerization,  2. Polymers establish structure-property connections  3. Methods and practices for the design of new polymeric products comprehend,  4. Learn how to carry out the synthesis of block and graft copolymers,  5. Illustrate the different types of polymer  6. Illuminate different analysis methods known structure of the polymer material. | | | | | | | |
| **TEXTBOOK** | | | | | Polymer Chemistry (M. Saçak, Gazi yayınları) | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Textbook of Polymer Science (Billmeyer)2. Polymers:Chemistry and Physics of Modern Materials (JMG Cowie-1991)3. Principles of Polymerisation (Odian)4. Organic Chemistry (L.G. Wade) | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, fundamental principles, syntheses methods of mocromolecules |
| 2 | Condensation and addition polymerization |
| 3 | Mass, solution, suspension polymerization methods |
| 4 | Emulsion, inverse emulsion, microemulsion polymerization methods |
| 5 | Iterfacial polymerization methods |
| 6 | Midterm Examination 1 |
| 7 | Methods and practices for the design of new polymeric products, block and graft copolymers, synthesis methods |
| 8 | Methods and practices for the design of new polymeric products, block and graft copolymers, synthesis methods |
| 9 | Polymer gels and structure-property connections |
| 10 | Polymer modification, determination of the physical properties of the polymer material |
| 11 | Midterm Examination 2 |
| 12 | Structure determination of unknown polymer material thermal (DSC), gel permeation chromatography (GPC) |
| 13 | Structure determination of unknown polymer material spectroscopic (UV-VIS, IR, NMR) analysis techniques |
| 14 | Viscometry, osmometri measurement methods, experimental work shall be done on issues such as the processing of polymers |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**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** | 501011101 | **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. | | |  | |  |  |
| **LO 2** | Being able to have researcher qualification with occupational sense of responsibility. | | |  | |  |  |
| **LO 3** | Becoming skillful at analyzing and reporting the data obtained in scientific researches. | | |  | |  |  |
| **LO 4** | Gaining awareness on ethical principles at basic research methods. | | |  | |  |  |
| **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** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Advanced Liquid NMR Techniques |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 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 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 60 |
| **PREREQUISITE(S)** | | | | | Absent | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Characterization of organic molecules and nanosized materials by liquid NMR, Determination of carbon atoms in the chemical structure of the material by various carbon NMR experiments (DEPT, APT, copuled), Determination of the bonds of hydrogen atoms with each other up to 4 bonds in the chemical structure by determining the proton-proton neighborhoods with the COSY NMR experiment, NOESY NMR experiment, determination of spatial interactions of hydrogen atoms in chemical structure and determination of isomer structures, determination of proton-carbon neighborhoods with HETCOR and HMBC NMR experiments, determination of diffusion coefficients of materials in organic solution with DOSY NMR experiment, determination of diffusion coefficients of materials in organic solution with DOSY NMR experiment. determination of the substance, determination of the amount of each substance in the sample with the qNMR technique, calculating the degree of crosslinking of the polymer samples using carbon experiments and other 2D experiments, and determining the conformation of the polymers. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To enable the chemical structures and isomer forms of polymer samples and other nanomaterials to be determined by detailed liquid NMR experiments. To enable students to become familiar with liquid NMR experiments and the data obtained from these denier, and to enable them to easily characterize structures with NMR experiments. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Pre-recognition of NMR devices widely used in the industry and advanced techniques used in this device and, if necessary, having prior knowledge in the use and interpretation of this device or methods in business life. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | At the end of this course, students;  1. They know the hydrogen and carbon atom neighborhoods of polymers and nano-sized materials and the measurement principles.  2. Have the equipment to use NMR spectroscopy and interpret the data obtained in determining the chemical structures of polymers and nano-sized materials, determining intramolecular/intermolecular interactions and determining conformational states.  3. They can determine the amount of materials consisting of organic and some inorganic molecules. | | | | | | | |
| **TEXTBOOK** | | | | | Metin Balcı, "Nukleer Manyetik Rezonans", METU Press, Ankara, 2000J.E.Baldwin, FRS and R.M. Williams, "High Resolution NMR Techniques in Organic Chemistry", Pergamon Press, 1999.-T. D.W.Claridge, "High-Resolution NMR Techniques in Organic Chemistry", Pergamon Press. 1999-H. Günther, "NMR-Spektroskopie", Georg Thime verlag, Stuttgart, New York, 1983.-M. Hesse, H. Meier, B. Zeeh, "Spektroskopische Methoden in der organische Chemie", Georg Thime verlag, Stuttgart, New York, 1991.-J. B. Lambert, H. F. Shurvell, D. A. Lightner, R. G. Cooks, 'Organic Structural Spectroscopy', Prentice hall, 1998 | | | | | | | |
| **OTHER REFERENCES** | | | | |  | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Overview of the NMR instrument and 2D NMR experiments |
| 2 | 13C NMR experiment and interpretation of the obtained spectrum |
| 3 | 13C APT NMR experiment and interpretation of the obtained spectrum |
| 4 | 13C DEPT (45, 90 and 135) NMR experiment and interpretation of the obtained spectrum |
| 5 | Performing the COSY NMR experiment and interpreting the obtained spectrum |
| 6 | Midterm |
| 7 | Performing the NOESY NMR experiment and interpreting the obtained spectrum |
| 8 | HMBC and HETCOR NMR experimentation and interpretation of the obtained spectrum |
| 9 | HMQC NMR experiment and interpretation of the obtained spectrum |
| 10 | Determination of T1 and T2 relaxation times of proton and carbon atoms and interpretation of the obtained spectrum |
| 11 | Determination of different components by DOSY NMR experiment |
| 12 | Performing qNMR NMR experiment and determining the amount of substance |
| 13 | Extraction of explicit formulas of molecules given one-dimensional and 2-dimensional NMR spectra |
| 14 | Extraction of explicit formulas of molecules given one-dimensional and 2-dimensional NMR spectra |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. | | |  | |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. | | |  | |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. | | |  | |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process | | |  | |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. | | |  | |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field | | |  | |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. | | |  | |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. | | |  | |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. | | |  | |  |  |
| **Prepared by :** | | | Assoc. Prof. Dr. Gokhan DIKMEN | **Date:** | | 06.06.2022 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Advanced Solid NMR Techniques |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 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 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 60 |
| **PREREQUISITE(S)** | | | | | Absent | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Characterization of molecules insoluble in any organic solvent, nanosized materials with solid NMR, obtaining carbon NMR spectra of crystalline and amorphous materials, Determination of carbon atoms in the chemical structure of the material by various carbon NMR experiments (DEPT, APT, copuled), Determination of Si/Al ratios, COSY Determination of proton-proton neighborhoods with NMR experiment, determination of hydrogen atoms bonds with each other up to 4 bonds in chemical structure, determination of spatial interactions of hydrogen atoms in chemical structure and determination of isomer structures, determination of proton-carbon neighborhoods with HETCOR and HMBC NMR experiments, Carbon experiments and other Calculation of crosslink degrees of polymer samples and determination of conformation of polymers using 2D experiments | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To enable the chemical structures and isomer forms of polymer samples and other nanomaterials to be determined by detailed solid NMR experiments. To enable students to become familiar with solid NMR experiments and the data obtained from these experiments, and to enable them to easily characterize structures with solid NMR experiments. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To have prior knowledge of solid NMR devices and advanced techniques used in this device and, if necessary, to have prior knowledge in the use and interpretation of this device or methods in business life. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | At the end of this course, students;  1. Have knowledge about the amorphous and crystalline structures of polymers and nano-sized materials and know the measurement principles.  2. Have the equipment to use solid NMR spectroscopy and interpret the data obtained in determining the chemical structures of polymers and nano-sized materials, determining intramolecular/intermolecular interactions and determining conformational states.  3. Gain knowledge about the Si/Al ratios of materials consisting of organic and some inorganic molecules and how many different types of groups exist. | | | | | | | |
| **TEXTBOOK** | | | | | Bakhmutov, Vladimir. I. Sıvılarda ve Katılarda NMR Spektroskopisi. CRC Press, 2015. Baskı: 1. . ISBN 978-1482262704 , ISBN 1482262703 . | | | | | | | |
| **OTHER REFERENCES** | | | | | Bakhmutov, Vladimir. I. Sıvılarda ve Katılarda NMR Spektroskopisi. CRC Press, 2015. Baskı: 1. . ISBN 978-1482262704 , ISBN 1482262703 . | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | NMR device and MAS spectrum overview |
| 2 | 13C CP-MAS NMR experiment and interpretation of the obtained spectrum |
| 3 | 13C SOLID NMR experiment and interpretation of the obtained spectrum |
| 4 | 13C DEPT INADEQUATE NMR experiment and interpretation of the obtained spectrum |
| 5 | Performing the COSY NMR experiment and interpreting the obtained spectrum |
| 6 | Midterm |
| 7 | Performing the NOESY NMR experiment and interpreting the obtained spectrum |
| 8 | HMBC and HETCOR NMR experimentation and interpretation of the obtained spectrum |
| 9 | HMQC NMR experiment and interpretation of the obtained spectrum |
| 10 | Determination of T1 and T2 relaxation times of proton and carbon atoms and interpretation of the obtained spectrum |
| 11 | Determination of amorphous and crystalline structures by T1 Echo experiments |
| 12 | Performing the HAHN ECHO experiment and investigating sp hybrids |
| 13 | Interpretation of one-dimensional and 2-dimensional NMR spectra |
| 14 | Interpretation of one-dimensional and 2-dimensional NMR spectra |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO 1** | By doing effective literature search and research in the field of polymer science and technology, to gain ability to reach and evaluate the knowledge deeply and widely and to gain the ability to interpret and apply. | | |  | |  |  |
| **LO 2** | Detailed knowledge about the latest techniques and methods applied in PBT field and having extensive knowledge about their limitations. | | |  | |  |  |
| **LO 3** | Ability to develop new and/or original ideas and methods; capability to find or develop innovative/alternative solutions to complex problems encountered during the research process. | | |  | |  |  |
| **LO 4** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process | | |  | |  |  |
| **LO 5** | Ability to understand what they read using a foreign language at a sufficient level and gain oral and written communication skills. | | |  | |  |  |
| **LO 6** | Be familiar with, and partly to gain the ability to use advanced technology featured in PBT field | | |  | |  |  |
| **LO 7** | Ability to identify and formulate Polymer Science and Technology related problems and in order to solve these problems, to gain the necessary practical skills to develop novel methods and apply innovative alternatives. | | |  | |  |  |
| **LO 8** | Ability to express or transfer the process and results of the study systematically and clearly in both national and international environment by express in writing or orally. | | |  | |  |  |
| **LO 9** | Ability to work effectively in interdisciplinary and multidisciplinary teams, to make leadership in this kind of team and to develop solutions to complex situations, ability to work independently and take responsibility. | | |  | |  |  |
| **Prepared by :** | | | Assoc. Prof. Dr. Gokhan DIKMEN | **Date:** | | 06.06.2022 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Functional Polymers and Modifications |

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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 (√)]** | | | | | | |
| 0 | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The new design and polymerization of monomers, polymer-assisted chemical reactions, polymer bound metal catalysts, phase transfer catalysts, affinity chromatography, enzyme immobilization, selective ion transport solar energy applications and Functional Polymers. Polymer modification methodsKinetics and mechanism of polymer modification industrial engineering such as PVC, polystyrene, cellulose polymers. Modified polymer properties and applications. Surface modification methods. Characterization of the modified polymers | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Basic concepts related to functional polymers, polymer modification reactions to reveal the structural effects, modification methods, characterization and application of information about the areas, and industry growth and the needs of individuals with adequate facilities to ensure responsivity. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Ensures that the student has a solid infrastructure polymer chemistry | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. defines the basic concepts of Functional polymers.  2. knowledge about the modification of polymers reactions.  3.Estimate the impact on the structural properties of the polymer modification reaction.  4. information about the Modification methods and characterization,  5. Learns the location in industry of modified polymers | | | | | | | |
| **TEXTBOOK** | | | | | Electrochromism: Fundamental and Applications. Paul M. S. Monk, Roger J. Mortimer, David R. Rosseinsky.Verlagsgesellschaft. 1995. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. A.Ravve, Principles of Polym Chem, 2. ed. (2000) Kluwer Acad. Publishers., 2. A.O.Patil, D.N.Schulz, B.M.Novak, Functional Polymers: Modern Synthetic Methods and Novel Structures, ACS Publications, ACS Symposium Series 704, 1997-USA. 3. K.Takemoto, R.M.Ottenbrite, M.Kamachi, Functional Polymers and Monomers, 2. ed. (1997) Marcel Dekker. 4. Warshawsky A, Synthesis and Separations Using Functional Polymers, (1991) John Wiley &Sons.E.Tsuchida 5. M. Lazar, T. Blaha, J. Rychly, Chemical Reactions of Natural and Synthetic Polymers, Ellis Horwood Limited publishers, UK, 1989. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, pre-concepts, macromolecules characteristic properties of chemical reactions; effect of visinal groups, media effect, chains interaction |
| 2 | The new design and polymerization of monomers |
| 3 | Polymer-assisted chemical reactions, polymer bound metal catalysts, phase transfer catalysts |
| 4 | Affinity chromatography, enzyme immobilization |
| 5 | Selective ion transport solar energy applications and functional Polymers |
| 6 | Midterm Examination 1 |
| 7 | Structural unit modification in polymers chains; hydrocarbon polymers, polymers reactions the heteroatom |
| 8 | Branching of macromolecule, branching polymers and graft copolymers  Bonding of macromolecule and cross bonding; cross bonding types, cross bonding methods, the last groups reactions |
| 9 | Substitution reactions of the polymer chairs, macromolecules degradation reactions; feat, light burning, oxidation, degradation with ozone, ionic degradation, radiolitic degradation, biodegradation |
| 10 | New type properties of modified polymers; transformation reactions, solubility, transmittance, surface properties, mechanic properties and electrical properties |
| 11 | Midterm Examination 2 |
| 12 | Polymer modification methods Kinetics and mechanism of polymer modification industrial engineering such as PVC, polystyrene, cellulose polymers |
| 13 | Surface modification methods. Characterization of the modified polymers |
| 14 | Modified polymer properties and applications; modified polymers, semipermeable membrane, polymers is grafted by functional groups, modeling of biopolymer functions |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Prof. Dr. Vural Bütün **Date:** 02.04.15

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **POLYMER SCIENCE AND TECHNOLOGY (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 505411608 | **TITLE** | Polymer Composites |

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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 (√)]** | | | | | | |
|  | |  | | | | 0 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 20 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction to composite materials, the advantages of composite materials, composite components: matrix and reinforcements, common production methods of polymer composites, the properties of polymer composites (morphologic, thermal, mechanic etc.), the applications of polymer composites. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Providing the students to gain thorough knowledge about the components of composite materials, the properties of polymer composites and the methods determining these properties, the applications of polymer composites and the technological developments at those applications. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students will be able to understand the importance of polymer composites among the other material technologies, learn the production methods and the scientific studies at this subject, improve the written and oral communication skills by doing and presenting the homework, in addition to these; they will be able to understand the importance of life-long learning and get application skills. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students recognize the composite materials, entitle the components of composites, classify the components to sub classes and explain them.  2. Students say the differences/similarities of polymer composites with the polymers.  3.Students describe the production methods of polymer composites and explain the properties.  4. Students examine and evaluate the applications of composites.  5. Student examines, describes and chooses while preparing the homework, defends and evaluates while presenting it. | | | | | | | |
| **TEXTBOOK** | | | | | 1. Şahin, Y.,“Kompozit Malzemelere Giriş”, Seçkin Yay.San.veTic.AŞ, 2006 2. Kelly, A. and Zweben, C., “Comprehensive Composite Materials”, Amsterdam: Elsevier, 2000. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Matthews F.L. and Rawlings R.D., “Composite Materials: Engineering and Science”, CRC Press, 1999 2. Mai Y.W. and Yu Z.Z., “Polymer nanocomposites”,Woodhead Pub.,2006. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Composite Materials |
| 2 | The components of composites: matrix and reinforcements |
| 3 | Important polymer composites |
| 4 | The production methods of thermoplastic polymer composites |
| 5 | The production methods of thermoset polymer composites |
| 6 | Midterm Examination 1 |
| 7 | The properties of polymer composites |
| 8 | The interactions of composite components and the effect of it to the properties |
| 9 | The determination of polymer composite properties |
| 10 | The applications of polymer composites |
| 11 | Midterm Examination 2 |
| 12 | The applications of polymer composites and the advantages of them |
| 13 | Polymer composites at nanocomposite technology |
| 14 | Homework presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE POLYMER SCIENCE AND TECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to understand at the highest level of the basic sciences and engineering sciences which are necessary in Polymer Science and Technology and other related areas. |  |  |  |
| **LO 2** | Capability to access to the latest information in PBT area and other related areas, Ability to design, plan, manage, finalize and apply original research process which bring innovations in science or technology, independently. |  |  |  |
| **LO 3** | Ability to use and control advanced technologies which are prominent in the fields of production, processing and characterization in PBT area. |  |  |  |
| **LO 4** | Ability to design, plan, manage, finalize and apply an innovative multi-disciplinary work. |  |  |  |
| **LO 5** | Ability to present the outcomes of academic studies in the academic environment and all kinds of respectable publications. |  |  |  |
| **LO 6** | Ability to make critical analysis, synthesis and evaluation of the ideas and developments put forward in the study area. |  |  |  |
| **LO 7** | To use at least one foreign language at an adequate level, to establish writing, oral and visual communication and ability to discuss with this language at an advanced level. |  |  |  |
| **LO 8** | Ability to evaluate current scientific, technological, social, cultural and environmental developments and to have scientific objectivity and ethic responsibility. |  |  |  |
| **LO 9** |  |  |  |  |

**Prepared by** **:** Dr. Demet Topaloğlu Yazıcı **Date:** 02.04.15

**Signature**: