**NANOSCIENCE AND NANTECHNOLOGY MSc 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](#EN16) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 505502501 | [NANOSTRUCTURED MATERIALS](#EN1) | 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 |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | Turkish |
| 505502001 | 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 |
| 505501702 | MSc THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 505501703 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of III. Semester  | 30 |  |  |  |  |
| **IV. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505501702 | MSc THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 505501703 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of IV. Semester  | 30 |  |  |  |  |
|  | TOTAL OF SECOND YEAR | 60 |  |  |  |  |

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| **Elective Courses** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505502510 | [Electrophoretic Deposition for Nanomaterials](#EN20) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501503 | [ENVIRONMENTAL ASPECTS OF NANOTECHNOLOGY](#EN2) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502504 | [FUNDAMENTAL OF MATERIALS SCIENCE](#EN4) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502506 | [METALLIC AND ORGANIC NANOCOATING](#EN5) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501504 | [MICRO-NANO INTERFACE PROCESSES](#EN6) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501505 | [NANOFABRICATION TECHNIQUES](#EN15) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501501 | [NANO-MATERIALS: THERMODYANAMICS AND KINETICS](#EN8) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501507 | [f](#EN19) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502502 | [NANOTECHNOLOGICAL APPROACHES IN MATERIALS FOR SUSTAINABLE ENERGY APPLICATIONS](#EN10) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501502 | [POLYMERIC-NANO MATERIALS STRUCTURE AND PROPERTIES](#EN12) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502507 | [PRODUCTION TECHNOLOGIES OF NANOSTRUCTURED POWDERS BY](#EN11) [LIQUID-PHASE SYNTHESIS](#EN11) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502503 | [SELECTED TOPICS IN MATERIALS SCIENCE AND NANOTECHNOLOGY](#EN13) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502505 | [THERMODYNAMICS AND STATISTICAL MECHANICS](#EN14) | 7.5 | 3+0 | 3 | E | Turkish |
| 505502508 | [THIN FILM COATING TECHNOLOGY](#EN17) | 7.5 | 3+0 | 3 | E | Turkish |
| 505501506 | [VACUUM COATING TECHNOLOGY](#EN18) | 7.5 | 3+0 | 3 | E | Turkish |

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502501 | **TITLE** |  Nanostructured Materials |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  |    |    | 3  | 7,5 | COMPULSORY( X ) | ELECTIVE(   ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | X |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  NanoStructured Material Synthesis, Chemical, Mechanical, Electrical, Optic and Magnetic Properties, Characterizations and Applications. |
| **COURSE OBJECTIVES** |  Advanced understanding of the synthesis of nano- structured materials, synthesis-material properties relationships and applications  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1. Understanding of synthesis methods of nano-structured materials.2. Understanding of relationships between synthesis methods and materials properties.3. Understanding of characterization methods of synthesized nano-structured materials. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understands the synthesis characteristics of nano-structured materials Understands the developments in the materials properties depending on the synthesis methodsUnderstands the characterization bases of the the nano-structured materials. |
| **TEXTBOOK** |  C.C. Koch, Nanostructured Materials, Noyes Publication, 2002. |
| **OTHER REFERENCES** |  A.S. Edelstein, R.C. Cammarata, Nanomaterials, Institute of Physics Publishing, 2001. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Synthesis of the Nano-Powders |
| 2 |  Synthesis of the Thin Films |
| 3 |  Synthesis of the Nanocrystal Materials by Thermal Spray  |
| 4 |  Synthesis of the Nano-Structured Composites by solid-state Methods |
| 5 |  Synthesis of the Nano-Structured Materials by Electro-Deposition  |
| 6 | Midterm Examination 1 |
| 7 |  Diffusion in Nanocrystal Materials  |
| 8 |  Gas-Reactive Applications of the Nanocrystal Materials |
| 9 |  Mechanical Properties of Nanocrystal Materials |
| 10 |  Mechanical Properties of Nanocrystal Materials |
| 11 | Midterm Examination 2 |
| 12 |  Electrical Properties of Nanocrystal Materials |
| 13 |  Optical Properties of Nanocrystal Materials |
| 14 |  Magnetic Properties of Nanocrystal Materials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Prof. Dr. Mustafa ANIK | **Date:** |  13.05.2015 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Environmental Aspects of Nanotechnology |

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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 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Related definitions, measurements for the characterization of nanomaterials, nanoparticles, nanofilms, gain knowledge of production of nanomaterial, environmental impacts of nanotechnology, fate and transport of nanoparticles in the environment, toxicity of nanoparticles and measurements, the most common applied nanomaterials and their properties, application nanoparticles for the pollution control, development of ecological surface with nanofilms. |
| **COURSE OBJECTIVES** |  Learn about types, production methods, application areas and possible damages of nano materials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Nanotechnology is a rapidly growing discipline in recent years, to have knowledge about its use for the benefit of the environment |
| **LEARNING OUTCOMES OF THE COURSE** |  Students1. learn related definitions about nanotechnology2. gain knowledge about production of nanomaterials, 3. learn how the spread and transport of nanoparticles to the environment 4. toxicological effects of nanomaterials and measurement methods to be gained5. Acknowledgement of nanotechnology used in pollution control |
| **TEXTBOOK** |  1.Environmental Nanotechnology: Applications and Impacts of Nanomaterials, Mark Wiesner, Jean-Yves Bottero, McGraw Hill, 2008. 2.Erkoç, Ş. (2007), Nanobilim ve Nanoteknoloji, ODTÜ Yayıncılık ve . İletişim |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to nanotechnology |
| 2 |  Nano materials; nanotubes, nanocrystals, nanoparticles |
| 3 |  Nano materials; nanoporous solids, thin films |
| 4 |  Production technology of nanomaterials |
| 5 |  Various application areas of nanotechnology |
| 6 | Midterm Examination 1 |
| 7 |  Environmental applications of nanotechnology |
| 8 |  Environmental applications of nanotechnology |
| 9 |  Nano-materials as waste |
| 10 |  Toxicological effects of nanomaterials and exposure pathways |
| 11 | Midterm Examination 2 |
| 12 |  The fate of nanomaterials in water |
| 13 |  The fate of nanomaterials in the soil |
| 14 |  The fate of nanomaterials in the airl |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[ ]**  | **[ ]**  |

**Prepared by:** Asst.Prof.Dr.Naile Karakehya **Date:**

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505511601 | **TITLE** |  Experimental Methods |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  |    |    | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( X ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| X |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 1 | 20 |
| Project |   |    |
| Report | 1 | 20 |
| Other (     ) |   |    |
| **Final Examination** | 30 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Electrical properties of solids, Semiconductor Devices, Analog-Digital Converters, Vacuum Technology, The thin film production techniques , Scanning Tunnelin Microscope, Atomic Force Microscope, Auger Electron Spectroscopy  |
| **COURSE OBJECTIVES** |  Techniques needed for the research will be taught in advanced level.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1.Ability to explain natural phenomena and analysis2. Ability to the sample production and characterization of fabricated samples 3. Ability to monitor current issues of professional |
| **LEARNING OUTCOMES OF THE COURSE** |  That course will contribute to the Project and MS / PhD thesis studies |
| **TEXTBOOK** |  R. A Dunlap, Experimental Physics, Oxford University Press, 1988 |
| **OTHER REFERENCES** |  C. Kittel, Introduction to Solid State Physics, John Wiley & Sons, Inc., New York, 1996 |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Energy levels in one dimension, free electron gas in three dimension, electrical conductivity and Ohm’s law  |
| 2 |  Experimental electrical resistivity of metals, Motion in magnetic fields, Hall effects  |
| 3 |  Semiconductors, I-V characteristics |
| 4 |  Semiconductor devices |
| 5 |  Analog- digital converters |
| 6 | Midterm Examination 1 |
| 7 |  Vacuum Technology  |
| 8 |  Thin Film Production Techniques |
| 9 |  Scanning Tunneling Microscope |
| 10 |  Atomic Force Microscope |
| 11 | Midterm Examination 2 |
| 12 |  Auger Electron Spectroskopy |
| 13 |  Introduction and application of AFM instrument (AFM analysis of CdS thin film)  |
| 14 |  Investigation of a metal surface using STM  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Understanding the interdisciplinary interactions in nanoscience and nanotechnology; getting original results by using the professional knowledge in the analysis of the novel and complex ideas, synthesis and evaluations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Contribution to the solutions of social, scientific, cultural and ethical problems encountered in the applications of nanoscience and nanotechnology, and supporting of the related developments. | **[x]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Prof.Dr. M. Celalettin BAYKUL | **Date:** |  4.10.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502504 | **TITLE** |  FUNDAMENTAL OF MATERIALS SCIENCE  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY( X ) | ELECTIVE( X ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 2 | 3 |  5  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 50 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Fundamental properties of materials, and thir applications, changing the some properties of materials for desired applications, utilizing the materilas science in industrial applications, phase transformations, and designing the right material for the right appliation |
| **COURSE OBJECTIVES** |  The relationship between materials science and nanotechnology, introduction to synthesis ofnano sized materials, and some knowledge about nano structures. The synthesis techniques and their applications |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The student will be aware of materials science, and will widen his horizon about producing useful materials |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Students will recognize the main properties of materials.2. Students will predict which production method is useful to desired materials for right application.3. Students will know which properties of materials will be applicable to application areas. |
| **TEXTBOOK** |  1. Fundamentals of Materials Science and Engineering, William D.Callister, David G.Rethwisch, John Wiley & Sons, 2008.2. Materials Engineering Science Processing and Design Michael Ashby, Hugh Shercliff, David Cebon, Butterworth Heinemann, 2007. |
| **OTHER REFERENCES** |  other resources for materials science |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Atomic bonding |
| 3 |  The structure of metals |
| 4 |  The structure of ceramics |
| 5 |  The structure of polymers |
| 6 | Midterm Examination 1 |
| 7 |  Faults in materials |
| 8 |  Mechanical properties |
| 9 |  Hardening mechanisms |
| 10 |  other properties of materials |
| 11 | Midterm Examination 2 |
| 12 |  Failure of materials |
| 13 |  Phase diagrams |
| 14 |  Phase transformations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Asst.Prof.Dr.Bedri BAKSAN | **Date:** |  08.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502506 | **TITLE** |  Metallic and Organic Nanocoating |

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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 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Electrochemical principles, the stability of the surface and equilibrium, metal coating, electrolytic-coating electroless coating organic coating, adsorption at interfaces, electrolytical coating with organic compounds (with polymers), , film formation, self assembled monolayers, the performance characteristics of the coating, interfacial films and coatings research |
| **COURSE OBJECTIVES** |  The main aim of the course is to teach the metallic and organic coatings on conductive surfaces and basic information on this subject. By this way, students gain a professional qualification and current researches related to monitoring and interpretation of the scientific method and research skills. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Coatings are used widely in industrial applications. Basic information on this subject provide the ability to design and conduct experiments as well as to analyse and interpret data that is obtained by electrochemical methods. |
| **LEARNING OUTCOMES OF THE COURSE** |  At the end of course, the student will be able to1) define the properties of metallic and organic coatings.2) design the application of electrolytic metal coating and interprets their results.3) design the application of coatings with organic substances and interprets their results.4) evaluate the performance characteristics of coatings and surface films. |
| **TEXTBOOK** |  Surface Coatings, M. Rizzo, G. Bruno, Nova Science Publishers, Inc., 2009. Organic Coatings: Science and Technology, Z. W. Wicks, Jr., F. N. Jones, S. P. Pappas, D. A. Wicks, Wiley-Interscience; 3 edition, 2007  |
| **OTHER REFERENCES** |  1.Metal kaplama ve elektrokimyasal teknolojiler, A.S. Saraç, Çağlayan Kitabevi, 1995  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Electrochemical principles |
| 2 |  The stability of the solid surface and equilibrium |
| 3 |  Metal coating, electrolytic-coating |
| 4 |  Electroless coating |
| 5 |  Organic coatings, film formation |
| 6 | Midterm Examination 1 |
| 7 |  Adsorption at interfaces |
| 8 |  Electrolytical coating with organic compounds (with polymers) |
| 9 |  Self assembled monolayers |
| 10 |  Thin films and their stabilities |
| 11 | Midterm Examination 2 |
| 12 |  The performance characteristics of the coatings |
| 13 |  Metallic coatings and interface researches |
| 14 |  Interfacial films and coatings research |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Prof.Dr. Aysel YURT | **Date:** |  13.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **NANOSCIENCE AND NANOTECHNOLOGY(MSc)** | **SEMESTER** |  |

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| **COURSE** |
| **CODE** |       | **TITLE** | Micro-Nano Interface Processes |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
| **MSc** | 3 | 0 | 0 | 3 | 7.5 | COMPULSORY( X ) | ELECTIVE(   ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| X |   |    |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** | - |
| **SHORT COURSE CONTENT** | Surface tension, Factors that affect the surface tension, Surface energy, Surface pressure, Diffusion coefficient, Classification of surface films, Electrical double layer, Properties of solid surfaces, Surface activity, Surface active compounds and their properties, Adsorption and adsorption isotherms, Adsorption of gases on solids, Adsorption solids from solution |
| **COURSE OBJECTIVES** | The main aim of the course is to teach the surface properties and mechanism of adsorption |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | To provide the ability to design and conduct experiments as well as to analyse and interpret data that is related with surface chemistry |
| **LEARNING OUTCOMES OF THE COURSE** | At the end of course, the student will be able toGain knowledge about surface tension, surface pressure and surface films, Identify the properties liquid-liquid interface, Gain knowledge about surface activity,Gain knowledge about properties of solid surface, Identify the properties of solid-liquid and solid-gas interface, Design and conduct experiments as well as to analyze and interpret data |
| **TEXTBOOK** | 1.Üneri, S. (1993). Asıltılar Kimyası. Ankara: Ankara Üniversitesi Yayınları 2. B.E. Conway, J.O’M. Bockris, R.E. White, Modern Aspects of Electrochemistry No:32, Kluwer Academic Publishers, New York, Boston, Dordrecht, London, Moscow, ISBN 0-306-46916-2 (2002). 3.Atıcı, O. (1991). Yüzey Aktif Maddeler. İstanbul : İTÜ Matbaası  |
| **OTHER REFERENCES** | Sarıkaya,Y. (2002). Fizikokimya. Ankara: Gazi Kitabevi.  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Surface tension and the factors affect the surface tension |
| 2 | Methods of surface tension measurement  |
| 3 | Surface energy , Surface pressure, Diffusion coefficient |
| 4 | The stability of the solid surface and equilibrium |
| 5 | Electrical double layer |
| 6 | Midterm Examination 1 |
| 7 | Surface activity and surface active compounds  |
| 8 | Properties and classification of surface active compounds  |
| 9 | Adsorption between interfaces  |
| 10 | Types of adsorption |
| 11 | Midterm Examination 2 |
| 12 | Adsorption isotherms,  |
| 13 | Adsorption of gases on solids,  |
| 14 | Adsorption on solids from solution |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGYMSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :** | Prof.Dr.Aysel Yurt | **Date:** | 05.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505512603 | **TITLE** |  Nanocomposites |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  |    |    | 3  |     | 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 | 25 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report | 1 | 25 |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Description of the composite, advantages and disadvantages, clasification, reinforcement materials, matrix materials, fabrication techniques, mechanical analysis, nanotechnology and nanomaterials, nanocomposites. |
| **COURSE OBJECTIVES** |  Teaching the composite materials; fabrication techniques, applications and mechanical properties of composite materials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The students learn the mentality of the composites, the materials properties used for fabrication of the composite materials. They will have ability to design and produce composite materials. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understanding of composite materials, have a knowlage on the constitutes, understanding the affect of constitutes, have an ability to produce and characterize a composite. |
| **TEXTBOOK** |  Introduction to composite materials Yusuf Şahin |
| **OTHER REFERENCES** |  ASM handbook, thesis |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  The description of composites, advantages and disadvantages  |
| 2 |  The clasifications of composites |
| 3 |  Reinforcement materials  |
| 4 |  Reinforcement materials |
| 5 |  Matrix materials |
| 6 | Midterm Examination 1 |
| 7 |  Fabrication methods of composites  |
| 8 |  Fabrication methods of composites |
| 9 |  Mechanical analysis of composites  |
| 10 |  Mechanical analysis of composites |
| 11 | Midterm Examination 2 |
| 12 |  Nanotechnology and nanomaterials |
| 13 |  Nanokomposites  |
| 14 |  Fabrication of nanocomposites |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Understanding the interdisciplinary interactions in nanoscience and nanotechnology; getting original results by using the professional knowledge in the analysis of the novel and complex ideas, synthesis and evaluations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Contribution to the solutions of social, scientific, cultural and ethical problems encountered in the applications of nanoscience and nanotechnology, and supporting of the related developments. | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Assi. Pr. Dr. İbrahim ÇELİKYÜREK | **Date:** |  08.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505501501 | **TITLE** |  NANO-MATERIALS: THERMODYANAMICS AND KINETICS |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Introduction, Fundamentals of Thermodynamics, Phase equilibria and Phase Diagrams, Surface and Size Effects, Surface and Size Effects on Kinetic Processes. |
| **COURSE OBJECTIVES** |  Advanced understanding of the surface and size effects on thermodynamic equilibrium and kinetics of processes in materials science |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Understanding of the surface and size effects on thermodynamic equilibrium.Understanding of the surface and size effects on the phase equilibrium.Understanding of the surface and size effects on the kinetics of materials. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understands the surface and size effects on thermodynamic equilibrium the surface and size effects on the phase equilibrium.Understands the surface and size effects on the kinetics of materials. |
| **TEXTBOOK** |  R. T. DeHoff, Thermodynamics in Materials Science, CRC Press, 2006. |
| **OTHER REFERENCES** |  A.S. Edelstein, R. C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, Institude of Physics Publishing, 2001. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fundamentals of Laws and Relations |
| 2 |  Fundamentals of Laws and Relations |
| 3 |  Surface and Size Effects |
| 4 |  Phase Equilibria and Phase Diagrams |
| 5 |  Phase Equilibria and Phase Diagrams |
| 6 | Midterm Examination 1 |
| 7 |  Surface and Size Effects |
| 8 |  Chemical Reactions: Thermodynamic Equilibrium  |
| 9 |  Chemical Reactions: Thermodynamic Equilibrium  |
| 10 |  Surface and Size Effects |
| 11 | Midterm Examination 2 |
| 12 |  Diffusion in Nanocrystalline Materials |
| 13 |  Phase Transformation Kinetics in Nanocrystalline Materials |
| 14 |  Phase Transformation Kinetics in Nanocrystalline Materials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Prof. Dr. Mustafa ANIK | **Date:** |  13.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505512604 | **TITLE** |  Nano Biomaterials |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **PhD** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 1 | 2 |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project | 1 | 20 |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Nanotechnology and Biomaterials, Synthesis of the nano biomaterials, Applications of nano- biomaterials |
| **COURSE OBJECTIVES** |  At the end of this course, the student will be able to; 1. evaluate importance of biomaterials in medicine2. give information about nano biomaterials and their properties and application areas.3. explain interactions between human body-nanomaterials and biocompatibility.. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Ability to define nano biomaterials  |
| **LEARNING OUTCOMES OF THE COURSE** |  1.Ability to determine and define medical problems;.2. Ability to formulate and solve medical problems;3.Ability to work effectively in multi-disciplinary teams;  4. Contribution to the solutions of cultural and ethical problems encountered in the applications of biomaterials.  |
| **TEXTBOOK** |  1.M. Giersig, G. B. Khomutov, Nanomaterials for Application in Medicine and Biology., 2006.2. D. Eichert, C.Drouet, H.Sfihia, C.Rey, C. Combes, Nanocrystalline apatite-based biomaterials, 2009. |
| **OTHER REFERENCES** |  1.Y. Gogotsi.,Nanomaterials handbook: Chapter 22, Nanotechnology and Biomaterials, 2006. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to biomaterials |
| 2 |  Nanotechnology and Biomaterials |
| 3 |  Biocompatibility and tissue-biomaterial interactions |
| 4 |  Classification of nano- biomaterials |
| 5 |  Ceramic nano biomaterials and their properties |
| 6 | Midterm Examination 1 |
| 7 |  Synthesis of the nano ceramics |
| 8 |  Applications of ceramic nano- biomaterial |
| 9 |  Applications of ceramic nano- biomaterials: Bone Cements |
| 10 |  Polymeric nano biomaterials and their properties |
| 11 | Midterm Examination 2 |
| 12 |  Nanocomposites |
| 13 |  Drug delivery sistems |
| 14 |  Nanotubes |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Understanding the interdisciplinary interactions in nanoscience and nanotechnology; getting original results by using the professional knowledge in the analysis of the novel and complex ideas, synthesis and evaluations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Contribution to the solutions of social, scientific, cultural and ethical problems encountered in the applications of nanoscience and nanotechnology, and supporting of the related developments. | **[x]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Asist. Prof. Dr. Nurşen Koç  | **Date:** |  26-5-2015 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502502 | **TITLE** |  Nanotechnological Approaches in Materials for Sustainable Energy Applications |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Nanostructured photovoltaicsNanostructures for electrical energy storageNanotechnology for hydrogen storageNanotechnology for improved lightingNanotechnology for thermoelectricsNanotechnology for thermal insulation |
| **COURSE OBJECTIVES** |  The aim of this course to give the students an understanding of importance about nanotechnology for sustainability: Energy conversion, storage, and conservation.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their knowledge about nanomaterials used in the field of sustainable energy.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Defines the basic principles of nanotechnology and nanomaterials. Describes the importance of the nanomaterials for the sustainable energy applications |
| **TEXTBOOK** |  Handbook of Nanostructured Materials and Nanotechnology,. Ed: Hari Singh Nalwa |
| **OTHER REFERENCES** |  DOE Fuel Cell HandbookOxford Handbook of Nanoscience and TechnologyHandbook of Hydrogen Storage: New Materials forFuture Energy Storage Edited by Michael Hirscher |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Smart Materials |
| 3 |  Nanostructured Photovoltaics-Organic  |
| 4 |  Nanostructured Photovoltaics-Inorganic |
| 5 |  Nanostructures for Electrical Energy Storage-Rechargeable batteries |
| 6 | Midterm Examination 1 |
| 7 |  Nanostructures for Electrical Energy Storage-Supercapacitors |
| 8 |  Nanotechnology for Hydrogen Storage |
| 9 |  Hydrogen Storage Materials |
| 10 |  Fuelcells |
| 11 | Midterm Examination 2 |
| 12 |  Nanotechnology for Improved Lighting |
| 13 |  Nanotechnology for Thermoelectrics |
| 14 |  Nanotechnology for Thermal Insulation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[x]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[x]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc. Prof.Dr. Hakan GAŞAN | **Date:** |  13.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Production Technologies of Nanostructured Powders by Liquid-Phase Synthesis  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 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 |   |    |
| Project |   |    |
| Report | 1 | 20 |
| Seminar |   |    |
| Other (presentation) | 1 | 10 |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  The production of nano-structured powders by a chemical reaction of inorganic metal compounds dispersed in the liquid phase. |
| **COURSE OBJECTIVES** |  It is aimed in this course review some of the most representative liquid-phase synthetic methodologies for the production of nano-structured powders. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To gain skills of establishing relation between the liquid- phase synthesis and nanotechnology. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Learn chemical reactions in the liquid-phase processes for producing nano-structred powders.2. Learn the effects of synthesis parameters on product properties.3. Understand the theory, process and technology of liquid-phase synthesis method.4. Contributes to the project and graduate studies |
| **TEXTBOOK** |  1. Caruntu, G., Caruntu, D., O'Connor, J.C., Encyclopedia of Inorganic Chemistry (2009). "Liquid-phase Synthesis of Nanoparticles" John Wiley&Sons.2. Cushing, B.L., Kolesnichenco, V.L.,O'Connor, J.C., Liqued-phase Synthesis of Inorganic Nanoparticles (2004). Chem. Rev., 104, 3893-3946. 3. Wright, J.D., Sommerdijk N.A..J.M., Sol-gel materials: chemistry and applications (2001). Gordon and Breach Science Publishers. |
| **OTHER REFERENCES** |  Other books, articles and presentations of related to the liquid-phase synthesis of nanoparticles. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Production of nanostructred powders by Coprecipitation method; theory and chemical reactions |
| 3 |  The coprecipitation synthetic methods |
| 4 |  Production of nanostructred powders by Sol-gel method; fundamentals of the Sol-gel process |
| 5 |  The Sol-gel synthetic methods |
| 6 | Midterm Examination 1 |
| 7 |  Production nanostructred powders by Hydrothermal/Solvothermal methods; principles of the hydrothermal/solvothermal methods  |
| 8 |  The hydrothermal and solvothermal methods |
| 9 |  Production of nanostructred powders by Polyol method; principles of the Polyol method |
| 10 |  Production of nanostructred powders by Microemulsiyon method; fundamentals of the microemulsiyons |
| 11 | Midterm Examination 2 |
| 12 |  The microemulsiyon synthetic methods |
| 13 |  Production of nanostructred powders by Pechini method; fundamentals and limitations of the Pechini method. |
| 14 |  Student presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assist.Prof.Dr. Belgin TANIŞAN  | **Date:** |  15.10.2015 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505501502 | **TITLE** |  Polymeric-Nano Materials Structure and Properties |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 20 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report | 1 | 30 |
| Seminar |   |    |
| Other (Presentation) | 1 | 10 |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  An overview of nano-structures and manufacturing techniques, information about particle and fiber-reinforced composites, explain frequently used nanofiber production techniques, an introduction for applications of polymeric nanofibers on biomedical, filtration and membrane technologies, and finally an overview of nano-coatings will be given.  |
| **COURSE OBJECTIVES** |  In general, the production of nano-sized and nano-polymeric materials, the information about features and future perspectives on the use of these materials will be discussed |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1.Understand and describe the information and manufacture methods of nanomaterials.2.Be able to follow these technologies and science.3.Understand and describe present and future problems, innovations and gain perspectives. |
| **LEARNING OUTCOMES OF THE COURSE** |  This course will contribute to the Project and MS / PhD thesis studies.      |
| **TEXTBOOK** |  1. Balasubramaniam, R. (2007). Callister'S Materials Science And Engineering: Indian Adaptation (W/Cd). John Wiley & Sons.2. Andrady, A. L. (2008). Science and technology of polymer nanofibers. John Wiley & Sons.3. Zhang, X. (2014). Fundamentals of Fiber Science. DEStech Pub. |
| **OTHER REFERENCES** |  Other books for polymeric-nano materials, articles, presentations and lecture notes. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Definition of nanotechnology, applications and importance  |
| 2 |  Manufacture / Engineering of Nanostructures  |
| 3 |  An overview of the synthesis of metal nanoparticles |
| 4 |  Particle-reinforced polymeric composites |
| 5 |  Fiber-reinforced composites |
| 6 | Midterm Examination 1 |
| 7 |  Nanofiber production techniques |
| 8 |  Biomedical Applications of Nanofibers |
| 9 |  Applications of Nanofiber Filtration & Separation  |
| 10 |  Polymeric-based Membranes and Their Applications |
| 11 | Midterm Examination 2 |
| 12 |  Coatings  |
| 13 |  Nano-coatings |
| 14 |  Presentations  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Yard. Doç. Dr. Hüseyin AVCI | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502503 | **TITLE** |  SELECTED TOPICS IN MATERIALS SCIENCE AND NANOTECHNOLOGY |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) |       |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 2 | 3 |  5  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 50 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Phase transformations in materials, and thir applications, nanosized materials, nanotubes, nanowires, and other nano materials, nanosized devices, amophous structures, and their applications area in nanotechnology |
| **COURSE OBJECTIVES** |  The relationship between materials science and nanotechnology, introduction to synthesis ofnano sized materials, and some knowledge about nano structures. The synthesis techniques and their applications |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The student will be aware of relationship between materials science and nanotechnology, and will widen his horizon about producing useful materials |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Students will recognize the relationship among the materials and nano sized materials.2. Students will predict which production method is useful to desired nanosized materials for right application.3. Students will know which properties of materials will be applicable to application areas. |
| **TEXTBOOK** |  1. Fundamentals of Materials Science and Engineering, William D.Callister, David G.Rethwisch, John Wiley & Sons, 2008.2. Borisenko, Victor E., and Stefano Ossicini. What is What in the Nanoworld: Handbook on Nanoscience and Nanotechnology. Weinheim: Wiley-VCH, 2005. |
| **OTHER REFERENCES** |  other resources for nano technology |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  What is nanotechnology? |
| 2 |  Motivation for nanotechnology |
| 3 |  Scaling of nano materials |
| 4 |  Nanometrology |
| 5 |  Raw materials of nanotechnology |
| 6 | Midterm Examination 1 |
| 7 |  Nanodevices |
| 8 |  Nano manufacturing |
| 9 |  Bio nanotechnology |
| 10 |  New fields of nanotechnology |
| 11 | Midterm Examination 2 |
| 12 |  Implications of nanotechnology |
| 13 |  Industrial applications |
| 14 |  Bio and medical applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Asst.Prof.Dr.Bedri BAKSAN | **Date:** |  08.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505502505 | **TITLE** |  Thermodynamics and Statistical Mechanics |

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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 |   |    |
| Quiz |   |    |
| Homework | 1 | 50 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Thermodynamics and Statistical Mechanics Approach,Thermodynamics laws and relations: entropy, Temperature, Free Energy,Introduction to probability theory, Probability density function,Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics with applications, Microstate and Numbers of Microstate |
| **COURSE OBJECTIVES** |  Introducing the basics of classical physics, the laws of thermodynamics and statistics and comprehend the relationship between them.With the help of statistical methods to determine the properties of the substance . |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To learn the basic concepts of equilibrium thermodynamics and statistical mechanics, Introduction to Probability Theory .The ability to obtain the physical properties of the substance is defined as a statistically |
| **LEARNING OUTCOMES OF THE COURSE** |  To explain a variety of physical phenomena and processes observed in nature we have to invoke physical laws on the microscopic (atomic) level. Guided by a basic knowledge of statistical physics the students are expected to fully understand and make proper analyses of physical problems related to temperature and energy. |
| **TEXTBOOK** |  Reif, Frederick (1965). Fundamentals of Statistical and Thermal Physics. McGraw-Hill. ISBN 0-07-051800-9. |
| **OTHER REFERENCES** |  W. Greiner et al. Thermodynamics and Statical Mechanics F. Schwabl, Statistical Mechanics |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Thermodynamics and Statistical Mechanics Approach |
| 2 |  Thermodynamics laws and relations: entropy, Temperature, Free Energy |
| 3 |  Thermodynamics laws and relations: entropy, Temperature, Free Energy |
| 4 |  Introduction to probability theory, Probability density function |
| 5 |  Binomial, Poisson and Gaussian distributions |
| 6 | Midterm Examination 1 |
| 7 |  Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics with applications. |
| 8 |  Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics with applications. |
| 9 |  Microstate,Phase space, Numbers of Microstate |
| 10 |  Microstate,Phase space, Numbers of Microstate |
| 11 | Midterm Examination 2 |
| 12 |  Definition of Hamiltonian operator in Quantum Mechanics |
| 13 |  Canonical ensemble and applications |
| 14 |  Canonical ensemble and applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Prof.Dr. M. Celalettin BAYKUL | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Nanofabrication Techniques |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  |    |    | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | Türkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  NA |
| **SHORT COURSE CONTENT** |  Introduction, Basic and Advanced Lithography Techniques, Basic and Advanced Deposition Techniques, Bonding Methods, Etching Methods (Dry and Wet etch), Scanning Probe Methods, Molecular Assembly, Techniques Developed towards Molecular Machines, Recent Advancements in Nanotechnolgoy  |
| **COURSE OBJECTIVES** |  1. Teaching students the techniques to fabricate micro- and nano-structured miniaturized devices (MEMS devices).2. Teachning students the material properties for the selection of a particular technique.3. Raising awarenes of the students about the recent technological achievements in the field. 4. Teaching students the multi-disciplinarity of fabrication techniques.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students will learn the fabrication techniques and material properties, to certain extend, and the potential application of the produced product. Student will also learn the impact of nanotechnology in several areas like engineering, chemisty, and health. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Students will learn which techniques are avaliable to fabricate micro- and nano-structured devices.2. Students will have the ability to recognise the techniques used for the production of a particular MEMS device.3. Student will be able to discuss and understand different techniques and materials chosen for the fabrication of such miniaturized devices.4. The course will also give students the chance to think globally and approach nanotechnology from a multi-disciplinary perspective where chemistry, material science, engineering, physics and biology are combined to create novel devices. |
| **TEXTBOOK** |  Marc J. Madou, Fundamentals of Microfabrication and Nanotecnology, 2011, CRC Press.  |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Micro- and Nano-fabrication technology |
| 2 |  Lithography techniques |
| 3 |  Deposition techniques |
| 4 |  Advanced deposition techniques |
| 5 |  Bonding methods |
| 6 | Midterm Examination 1 |
| 7 |  Etching-dry etching methodw |
| 8 |  Etching-Wet etching methods |
| 9 |  Advanced lithography techniques |
| 10 |  Scanning probe methods |
| 11 | Midterm Examination 2 |
| 12 |  Molecular self assembly |
| 13 |  Molecular machines |
| 14 |  Recent technological achievements |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Dr Fatma Doğan | **Date:** |  20.04.2016 |

**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. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Being able to have researcher qualification with occupational sense of responsibility.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Becoming skillful at analyzing and reporting the data obtained in scientific researches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Gaining awareness on ethical principles at basic research methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |   | **Date:** |  14.06.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |   Thin Film Coating Technology |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | TR |
| **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 | 2 | 50 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Vacuum coating systems, athmospheric plasma coating systems |
| **COURSE OBJECTIVES** |  Introduction, design and requirements to vacuum coating technologies  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Fundamental Informationand calculations about vacuum coating systems.      |
| **LEARNING OUTCOMES OF THE COURSE** |  Learn the fundamental of the vacuum coatings technology,Learn the systems and desgins of vacuum devices,Make the system analysis,Evaluation of the system requriemnts |
| **TEXTBOOK** |  Prof.Dr.Çelik Tarımcı, Dr.Hüseyin Sarı, Ankara 2006 |
| **OTHER REFERENCES** |  Gary E. McGuire, Stephen M. Rossnagel, Rointan F.Bunshah, 2001, Materials science and Processing Technology Series. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Vacuum technologies and thin film coatings |
| 2 |  RF sputtering systems |
| 3 |  Vacuum arc coatings |
| 4 |  Moleculer beam epitaxy |
| 5 |  Evaporation systems |
| 6 | Midterm Examination 1 |
| 7 |  System design and applicaitons |
| 8 |  Optical coatings  |
| 9 |  Surface characteristics of coatings |
| 10 |  Microstructural properties of coatings  |
| 11 | Midterm Examination 2 |
| 12 |  Atmospheric pressure coatings technologies |
| 13 |  Atmospheric pressure coatings technologies |
| 14 |  Atmospheric pressure coatings technologies |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc.Prof.Dr.Suat PAT | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Vacuum Coating Technology  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( x ) | TR |
| **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 | 2 | 50 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Vacuum and calculations, vacuum systems requirements, power supplies, thin film deposition |
| **COURSE OBJECTIVES** |  Introduction, design and requirements to vacuum coating technologies |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Fundamental informationand calculations about vacuum coating systems.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Learn the fundamental of the vacuum coatings technology,Learn the systems and desgins of vacuum devices,Make the system analysis,Evaluation of the system requriemnts |
| **TEXTBOOK** |  Prof.Dr.Çelik Tarımcı, Dr.Hüseyin Sarı, Ankara 2006 |
| **OTHER REFERENCES** |  Gary E. McGuire, Stephen M. Rossnagel, Rointan F.Bunshah, 2001, Materials science and Processing Technology Series. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fundamentals of vacuum coatings systems and applications |
| 2 |  Vacuum science |
| 3 |  Vacuum science and kinetic theory of gases |
| 4 |  vacuum pumping and calculations |
| 5 |  vacuum pumping and calculations |
| 6 | Midterm Examination 1 |
| 7 |  Vacuum measurements |
| 8 |  vacuum elements, components and mountings |
| 9 |  vacuum elements, components and mountings |
| 10 |  vacuum system power supply |
| 11 | Midterm Examination 2 |
| 12 |  Thicknes measurments and general remarks |
| 13 |  Vacuum coating system design |
| 14 |  Vacuum coating system design |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Self-confidence in dealing with the problems encountered in the engineering applications | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Understanding of professional and ethical issues. | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc.Prof.Dr.Suat PAT | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Electrophoretic Deposition for Nanomaterials |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 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 | 30 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Comprehending the basic aspects of EPD technique, teaching the factors affecting the deposition process, kinetic aspects, EPD types, driving forces, mechanisms in EPD, multi-component / composite deposition processes, applications.  |
| **COURSE OBJECTIVES** |  Understanding the EPD method preferred due to its advantages among coating methods, teaching basic knowledge, method processes, and technologies. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1. Learning the EPD method 2. Examining the parameters, mechanism and kinetic approach affecting the process together.3. To learn about traditional and advanced technology application areas |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Having basic knowledge about the EPD Coating2. Understanding the EPD mechanism, learned EPD kinetics and using it in practice,3. Knowledge about the application areas of EPD in today's technology from macro to nanoscale4. Training engineers who can analyse EPD process parameters.  |
| **TEXTBOOK** |  Electrophoretic Deposition of Nanomaterials; Editors:James H. Dickerson, Aldo R. Boccaccini |
| **OTHER REFERENCES** |  Articles related with EPD and course note  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to electrophoretic deposition (EPD) |
| 2 |  The Fundamentals of EPD, factors influencing EPD |
| 3 |  Electrophoretic deposition of materials |
| 4 |  Mechanisim of EPD process |
| 5 |  Kinetics of EPD process |
| 6 | Midterm Examination 1 |
| 7 |  Characterization methods |
| 8 |  Deposition of Microparticles |
| 9 |  Deposition of Nanoparticles  |
| 10 |  Deposition of Nanoparticles  |
| 11 | Midterm Examination 2 |
| 12 |  Application of EPD: CNT |
| 13 |  Application of EPD: Biomedical applications |
| 14 |  Application of EPD: Solid fuel cell |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE NANOSCIENCE AND NANOTECHNOLOGY MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | The synthesizing ability of the different information gathered from different disciplines in the framework of nanoscience and nanotechnology. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novel strategic approaches. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to develop, select and use modern methods and tools required for nanoscience and nanotechnology applications; ability to effective usage of information technologies. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to determine, define, formulate and solve complex nanoscience and nanotechnology problems; for that purpose an ability to select and use convenient analytical and experimental methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of criticizing and proposing alternatives in the professional subjects. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in Turkish/English; proficiency in at least one foreign language. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Assist. Prof. Dr. Yapıncak GÖNCÜ  | **Date:** |  13.11.2020 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **NANOSCIENCE AND NANOTECHNOLOGY (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  0 | **TITLE** |  Nanomaterial Characterization |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 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 | 20 |
| Quiz |   |    |
| Homework | 4 | 10 |
| Project | 2 | 30 |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  There is no prerequisite |
| **SHORT COURSE CONTENT** |  In this course, the fundamentals of nanotechnology, history, applications and new materials, synthesis and applications of nanomaterials, applications in industry, future trends, and emerging technologies are discussed.It provides basic information about nanomaterial characterization, focusing on the basic properties of nanomaterials and the different surface analytical techniques. In addition, this course focuses on synthesis and characterization techniques related to nanomaterial characterization. |
| **COURSE OBJECTIVES** |  Objective of this course is to teach nanomaterials, physical and chemical properties of nanomaterials, and synthesis and characterization methods of nanomaterials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Nanomaterials are used in industrial manufacturing, electronics and computers, aerospace, medicine and health, environment and energy, biotechnology and agriculture, defence fields. The course will contribute to ones working on nanomaterials in these areas to determine and understand the methods of preparing nanomaterials, surface modifications and surface crystal and electronic changes of nanomaterials.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1. To design and apply theoretical and applied research related to the field, developing original ideas and methods. 2. To solve complex situations encountered in his research on nanomaterials. 3. To transmit scientific studies related to nanotechnology in written and oral form in national and international settings. 4. Be able to make decisions about the surface of nanomaterials by analyzing the caraterization methods of nanomaterials in a good way. 5. To make nanoengineering evaluations by synthesizing engineering information by evaluating the surface properties of nanomaterials with characterization methods. 6. To assess and understand the effects of changes made in the nanodus on the macro-size.       |
| **TEXTBOOK** |  Ratna Tantra, Nanomaterial Characterization: An Introduction, ISBN: 978-1-118-75359-0, Wile 2016.  |
| **OTHER REFERENCES** |  1. Fevzi Köksal, Rahmi Köseoğlu, "Nanobilim ve Nanoteknoloji", Nobel Akademik Yayıncılık, 1. Baskı, Ankara 2014. 2. Tarık Baykara, "Nanoteknolojiler Dünyasına Doğru", Nobel Akademik Yayıncılık, 1. Baskı, Ankara 2016 |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Nanomaterials |
| 2 |  Surface knowledge of nanomaterials: stack phase and surface defects |
| 3 |  Surface information of nanomaterials: Cristallography |
| 4 |  Synthesis methods of nanomaterials |
| 5 |  Elemental analysis methods |
| 6 |  X-ray Diffractometry |
| 7 |  X-ray photoelectron spectroscopy, Auger spectroscopy |
| 8 |  X-ray Fluorescence spectroscopy |
| 9 |  Transmission Electron Microscopy,  |
| 10 |  Atomic Force Microscopy |
| 11 |  Scanning electron microscopy |
| 12 |  Solid NMR |
| 13 |  Microraman spectroscopy, chemisorption, and active site determination |
| 14 |  surface quantum chemical calculations and surface calculations with density functional theory |
| 15,16 | Final Examination |

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| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Extending the knowledge in mathematics, science, nanoscience and nanotechnology to the professional level, and understanding the interdisciplinary interactions among these subjects. | **[x]**  | **[ ]**  | **[ ]**  |
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| **Prepared by :**  |  Assoc. prof. Dr. Hilal DEMİR KIVRAK | **Date:** |  16.06.2021 |

**Signature**: