**NANOSCIENCE AND NANTECHNOLOGY ENGLISH 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](#d0) | 7.5 | 3+0 | 3 | **C** | English |
| 505602501 | [NANOMATERIALS](#d1) | 7.5 | 3+0 | 3 | **C** | English |
|  | Elective Course-1 | 7.5 | 3+0 | 3 | E | English |
|  | Elective Course-2 | 7.5 | 3+0 | 3 | E | English |
|  | 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 | English |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | English |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | English |
| 505602001 | Seminar | 7.5 | 0+1 | - | **C** | English |
|  | 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 |
| 505601702 | MSc THESIS STUDY | 25 | 0+1 | - | **C** | English |
| 505601703 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | English |
|  | Total of III. Semester  | 30 |  |  |  |  |
| **IV. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505601702 | MSc THESIS STUDY | 25 | 0+1 | - | **C** | English |
| 505601703 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | English |
|  | 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 |
| 505602502 | [POLYMERIC-NANO MATERIALS PRODUCTION AND APP.](#d2) | 7.5 | 3+0 | 3 | E | English |
| 505602503 | [NANOMATERIAL CHARACTERIZATION](#d3) | 7.5 | 3+0 | 3 | E | English |
| 505602504 | [BASICS OF MATERIALS SCIENCE](#d4) | 7.5 | 3+0 | 3 | E | English |
| 505602505 | [NANOMATERIALS IN BIOMEDICAL ENGINEERING](#d5) | 7.5 | 3+0 | 3 | E | English |
| 505602506 | [NANOFABRICATION TECHNIQUES](#d6) | 7.5 | 3+0 | 3 | E | English |
| 505602508 | [NANOMATERIALS IN SUSTAINABLE ENERGY PRODUCTION](#d12) | 7.5 | 3+0 | 3 | E | English |
| 505602507 | [CARBON NANOMATERIALS](#d7) | 7.5 | 3+0 | 3 | E | English |
| 505601501 | [MATERIALS FOR SENSING APPLICATIONS](#d10) | 7.5 | 3+0 | 3 | E | English |
| 505601502 | [PHYSICAL PROPERTIES OF MATERIALS](#d11) | 7.5 | 3+0 | 3 | E | English |

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  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:** |  |

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602504 | **TITLE** |  Basics 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(   ) | ELECTIVE( x ) | English |
| **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 |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  The focus this course will be on material properties, their relation to structure and composition of materials, and how these parameters can be altered through processing. We will deal with different types of materials including metals, ceramics, polymers and composites and discuss how materials selection is involved in engineering designs. |
| **COURSE OBJECTIVES** |  The objective of this course is to introduce the basics of materials science and engineering to students coming from different backgrounds.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Acquainting students who will gain expterties in the area of nanomaterials, with the he basics of materials science and engineering.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Understanding the structure-property-processing relationship in materials.Understanding the specific properties of different types of materials.Developing the ability to select the material type and processing route for a material to be used in in a target application, by estimating the resulting materials structure and properties.  |
| **TEXTBOOK** |  William D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, 10th edition  |
| **OTHER REFERENCES** |  Electronic data bases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to materials science |
| 2 |  Atomic structure and bonding in materials      |
| 3 |  Crystal structure of materials-1 |
| 4 |  Crystal structure of materials-2 |
| 5 |  Imperfections in crystals and deformation of materials |
| 6 |  Mechanical properties of materials-1 |
| 7 |  Mechanical properties of materials-2 |
| 8 |  Strengthening mechanisms in metals |
| 9 |  Phase diagrams |
| 10 |  Fe-C systems |
| 11 |  Diffusion |
| 12 |  Electrical, optical and thermal properties of materials, corrosion and degradation of materials |
| 13 |  Types, properties and production of metallic materials |
| 14 |  Types, properties and production of ceramic, polymeric and composite materials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[x]**  | **[ ]**  |

**Prepared by:** Assist.Prof.Dr. S.Mine Toker **Date:** 15.11.2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602507 | **TITLE** |  CARBON 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 ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 0 |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework |   |    |
| Project | 1 | 30 |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Introduction to low dimensional carbon materials, the effects of nanoscale on physical and chemical properties, and production, characterization and applications of carbon nanomaterials. |
| **COURSE OBJECTIVES** |  To investigate the properties and the behavior of carbon materials in nanoscale under the light of basic science, to have knowledge about the production, characterization and applications of carbon nanomaterials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To be able to recognize nanoscale carbon materials that form the basic part of the nanotechnological products which become very common in our daily lives, to have knowledge about the production and characterization methods of carbon nanomaterials, and to be able to develop new carbon based materials by examining their common and unique application areas. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. To have knowledge about the properties of carbon materials in nanoscale.2. Be able to create new application fields for nanoscale carbon materials considering their physical and chemical properties.3. Be able to produce and characterize novel nanosized carbon materials, and to develop new application fields for them.4. Be able to develop new research and application areas for various carbon nanomaterials with similar properties. |
| **TEXTBOOK** |  1. Y. Gogotsi, V. Presser, Carbon Nanomaterials, CRC Press, ISBN 9781138076815. |
| **OTHER REFERENCES** |  1. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J., Textbook of Nanoscience and Nanotechnology, Springer. ISBN 978-3-642-28030-6. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to low dimensional carbon materials |
| 2 |  Carbon hybridisation, Structural properties |
| 3 |  Characterization Techniques |
| 4 |  0D carbon nanomaterials |
| 5 |  1D carbon nanomaterials |
| 6 |  2D carbon nanomaterials |
| 7 |  Bulk carbon nanomaterials |
| 8 |  Midterm |
| 9 |  Heteroatom doped carbon structures |
| 10 |  Porous organic polymers |
| 11 |  Metal-organic frameworks |
| 12 |  Application Areas 1 |
| 13 |  Application Areas 2 |
| 14 |  Student presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[x]**  | **[ ]**  | **[ ]**  |

**Prepared by:** Assist. Prof. Recep Yuksel **Date:** 15.11.2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602506 | **TITLE** |  NANOFABRICATION TECHNIQUES |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 0 | X |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  There is no prerequisite |
| **SHORT COURSE CONTENT** |  Introduction nanofabrication techniques, The basics of nanotechnology and nanomaterials, fabrications and applications of quatum dots, nanotubes, nanowires, nanostructured thin films, 2-dimensional nano materials, nano grained materials, nanoporous materials and hybrid nano materials.       |
| **COURSE OBJECTIVES** |  1.Teaching to students the basics of nanomaterials and nanotechnology.2. Teaching students the techniques to synthesize nanomaterials with different dimensions and morphologies.3. Teachning students the material properties for the selection of a particular technique.4. Raising awarenes of the students about the recent technological achievements in the field. 5. 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 products. 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 materials.2. Students will have the ability to recognise the techniques used for the production of a particular nanomaterials.3. Student will be able to discuss and understand different techniques and materials chosen for the fabrication of nanomaterials with different geometries.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** |  Cao G., Nanostructures & Nanomaterials, 2004, ICP.    |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Nanotechnology and nanomaterials     |
| 2 |  Comparison of nanomaterials and their bulk counterparts |
| 3 |  Quantum Dots: Synthesis techniques and Applications |
| 4 |  Nano Particles: Synthesis techniques and Applications  |
| 5 |  Nanotubes: Synthesis techniques and Applications |
| 6 |  Nanowires: Synthesis techniques and Applications |
| 7 |  Nano-sized Thin Films: Synthesis techniques and Applications |
| 8 |  Midterm Examination |
| 9 |  Nano-sized Thin Films: Synthesis techniques and Applications |
| 10 |  2-D Nano Materials: Synthesis techniques and Applications |
| 11 |  2-D Nano Materials: Synthesis techniques and Applications |
| 12 |  Nano-grained Materials: Synthesis techniques and Applications |
| 13 |  Nano-porous Materials: Synthesis techniques and Applications |
| 14 |  Hybrid Nanostructures: Synhtesis techniques and Applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[x]**  | **[ ]**  |

**Prepared by:** Assist.Prof.Dr. Şahin COŞKUN **Date:** 15.11.2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602501 | **TITLE** |  NANOMATERIALS |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7.5 | COMPULSORY( X ) | ELECTIVE(   ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | 0 |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report | 1 | 30 |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Introduction, Thermodynamics of Nanomaterials, Kinetics of Nanomaterials, Synthesis Methods of Nanomaterials, Properties of Nanomaterials, Characterization of Nanomaterials |
| **COURSE OBJECTIVES** |  Comprehending the properties, synthesis principles and usage areas of the nanomaterials |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1. Understanding of the synthesis metahods of nanomaterials.2. Understanding of the relationships between synthesis methods and nanomaterial properties.3. Understanding of the characterization techniques of nanomaterials. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understand the synthesis aprroaches as the material dimensions reduces to nano lavelUnderstand the changes in materials properties as the material dimensions reduces to nano lavelLearn the nanomateria characterization techniques |
| **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 |  Nanomaterials - Introduction  |
| 2 |  Thermodynamics of Nanomaterials-1 |
| 3 |  Thermodynamics of Nanomaterials-2 |
| 4 |  Kinetics of Nanomaterials-1 |
| 5 |  Kinetics of Nanomaterials-2 |
| 6 |  Solid Phase Synthesis of Nanomaterials |
| 7 |  Liquid Phase Synthesis of Nanomaterials |
| 8 |  Gas Phase Synthesis of Nanomaterials |
| 9 |  Characterization Methods of Nanomaterials-1 |
| 10 |  Characterization Methods of Nanomaterials-2 |
| 11 |  Optical Properties of Nanomaterials |
| 12 |  Electrical Properties of Nanomaterials |
| 13 |  Magnetic Properties of Nanomaterials |
| 14 |  Mechanical Properties of Nanomaterials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[ ]**  | **[x]**  |

**Prepared by:** Prof. Dr. Mustafa ANIK **Date:** 12/11/2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602503 | **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 ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 0 |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 20 |
| Quiz |   |    |
| Homework | 1 | 10 |
| Project | 1 | 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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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[x]**  | **[ ]**  | **[ ]**  |

**Prepared by:** PROF. DR. HİLAL DEMİR KIVRAK **Date:** 11.11.2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602505 | **TITLE** |  Nanomaterials in Biomedical Engineering  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | English |
| **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 |   |    |
| Quiz |   |  |
| Homework |  |    |
| Project | 1 | 30 |
| Report | 1 | 20 |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  There is no prerequisite |
| **SHORT COURSE CONTENT** |  Description of nanomaterials in biomedical engineering, their application areas, types and properties of biomedical materials, biocompatibility, development of novel nanomaterials for biomedical applications, . nanofeatures of biological tissues and the way biomimetic materials are inspired by these tissues at the nanoscale. |
| **COURSE OBJECTIVES** |  This course aims to acquaint students with the nanomaterials used in the field of biomedical engineering. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Understanding the materials selection procedures for biomedical applications.Being informed about advaces in the nano materials field.Learning about the methods for biocompatibility improvement of nanomaterials for biomedical engineering applications.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Learning about the nanomaterials used in biomedical field and the types of materials used in these applications.Understanding the critical material properties for for nanomaterials in biomedical engineering and the concept of biocompatibility.Evaluating the applicability of nanotechnology for the development of novel biomaterials  |
| **TEXTBOOK** |  Biomaterials: An Introduction; Joon Park, R.S. Lakes; Springer (2010) |
| **OTHER REFERENCES** |  Electronic data bases  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction about the concepts of biomedical engineering, biomaterials and biocompatibility |
| 2 |  An overview on the current materials used in the field of biomedical engineering  |
| 3 |  Nanoscale materials for biomedical applications  |
| 4 |  Nanoscale features of conventional materials which enable their use as biomaterials |
| 5 |  The application areas of nanomaterials in biomedical engineering |
| 6 |  Nano-hydroxyapatite, quantum dots, nanomaterial reinforced biocomposites, nano-spheres |
| 7 |  Nanomaterials for tissue engineering, medical imaging and diagnosis, dental and orthopedic implants, controlled drug delivery |
| 8 |  Nanofeatures of biological tissues |
| 9 |  Biomimetic materials inspired by natural tissues at the nanoscale |
| 10 |  Application of nanotechnology for the development of novel biomaterials  |
| 11 |  Discussions on current literature on nanomaterials in biomedical engineering |
| 12 |  Discussions on current literature on nanomaterials in biomedical engineering |
| 13 |  Student project presentations |
| 14 |  Student project presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[x]**  | **[ ]**  |

**Prepared by:** Assist.Prof.Dr. S. Mine Toker **Date:** 15.11.2021

**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******(English)*** | **SEMESTER** | Spring |

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| **COURSE** |
| **CODE** | 505602502 | **TITLE** | Polymeric-Nano Materials Production and Applications |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
| **MSc** | 3 | 0 | 0 | 3 | 7,5 | COMPULSORY( ) | ELECTIVE( X ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (****)]** |
| 0 |  |  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution ( % )** |
| Midterm | 1 | 20 |
| Quiz |  |  |
| Homework |  |  |
| Project | 1 | 20 |
| Report |  |  |
| Seminar | 1 | 20 |
| Other (………) |  |  |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** | There is no prerequisite |
| **SHORT COURSE CONTENT** | An overview of nano-structures and manufacturing techniques, information about nano particle and polymeric nanomaterials, explain frequently used nanofiber production techniques, an introduction for applications ofpolymeric nano materials and fibers 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 thesematerials 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 various Projects 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. Challa S. S. R. Kumar (2011). Polymeric Nanomaterials, Wiley
 |
| **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 | Production of polymeric nanomaterials |
| 5 | Fiber-reinforced composites |
| 6 | Nanofiber production techniques |
| 7 | Midterm Exam |
| 8 | Biomedical Applications of polymeric nanomaterials |
| 9 | Applications of polymeric nanomaterials for filtration & separation |
| 10 | Polymeric-based Membranes and Their Applications |
| 11 | Nanofluidics |
| 12 | Nano-coatings |
| 13 | Presentations |
| 14 | Course Review |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE*****NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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 theinterdisciplinary interactions among these subjects. |  |  |  |
| **LO 2** | The synthesizing ability of the different information gathered fromdifferent disciplines in the framework of nanoscience and nanotechnology. |  |  |  |
| **LO 3** | Ability to work effectively in inner or multi-disciplinary teams; proficiencyof interdependence. |  |  |  |
| **LO 4** | Designing ability of the complex system, process, equipment or product under the realistic constraints and conditions by developing the novelstrategic approaches. |  |  |  |
| **LO 5** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and toevaluate the results obtained within the framework of quality processes. |  |  |  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. |  |  |  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual atthis foreign language |  |  |  |
| **LO 8** | Ability of effective usage of the information technologies |  |  |  |
| **LO 9** | Professional and ethical responsibility awareness |  |  |  |

**Prepared by:** Assoc. Prof. Hüseyin AVCI. D**ate:** 13.11.2021

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  PHYSICAL PROPERTIES OF MATERIALS |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| 0 | X |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  There is no prerequisite |
| **SHORT COURSE CONTENT** |  An introduction to physical properites of materials, electrical properties of materials, thermal properties of materials, optical properties of materials, magnetic properties of materials.      |
| **COURSE OBJECTIVES** |  1.Teaching to students the basics of physical properties of materials.2. Teaching students the mechanical properties of materials.3. Teachning students the electrical, magnetic, thermal and optical properties of materials.4. Raising awarenes of the students about the recent technological achievements in the field. 5. Teaching students the multi-disciplinarity of applications of materials.   |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students will learn basis of different physical properties of materials and their relations with microstructure. It will support while working on different materials groups on controlling mechanical, electrical, thermal, optical and magnetic properties.      |
| **LEARNING OUTCOMES OF THE COURSE** |  Learning of physical basis of materials’ properties. Learning of physical basis of mechanical properties of materials and microstructure relations.Learning of microstructure basis of electrical, thermal, optical and magnetic properties of materials.  |
| **TEXTBOOK** |  Physical Properties of Materials for Engineers By Daniel D. Pollock CALLISTER, W D. Materials Science and Engineering: An Introduction. New York : John Wiley & Sons, 2003. 820 p. ISBN 0-471-22471-5. |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  An introduction to physical properties of materials  |
| 2 |  Mechanical properties of materials |
| 3 |  Mechanical properties of materials |
| 4 |  Mechanical properties of materials |
| 5 |  Electircal properties of materials |
| 6 |  Electircal properties of materials |
| 7 |  Microstructure – electrical properties relations |
| 8 |  Midterm Examination |
| 9 |  Magnetic properties of materials |
| 10 |  Microstructure – magnetic properties relations |
| 11 |  Thermal properties of materials |
| 12 |  Microstructure – thermal properties relations |
| 13 |  Optical properties of materials |
| 14 |  Microstructure – optical properties relations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[x]**  | **[ ]**  |

**Prepared by:** Assist.Prof.Dr. Şahin COŞKUN **Date:** 22.04.2022

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  MATERIALS FOR SENSING APPLICATIONS |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 2  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | ENGLISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 50 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  This course will introduce students to the different Sensor concepts and sensor materials. And will discuss the theory, design and fabrication of chemical, physical, thermal, electrical, magnetic and optical sensors and sensor network.  |
| **COURSE OBJECTIVES** |  Advanced understanding of the sensors and sensing materials, design-material properties relationships and applications  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  At the end of the course, students are expected to show the ability to: 1. Understand the principles of different sensor types. 2. Understand the fundamentals of various wide range of sensing materials. 3. Understand the applications of different sensor devices. 4. Analyse the literature resources to assess wide range of information related to sensors and sensing materials. 5. Communicate effectively a literature review on sensing through a presentation to the class. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understands sensor principles, design, typesUnderstands the relation between sensors and materialsThe main structure of advanced sensing materials and devicesState‐of‐the‐art applications of these materials and devices |
| **TEXTBOOK** |  - Expanding the vision of sensors and materials, National Academy Press, Washington D.C. 1995- Related articles- Internet sources |
| **OTHER REFERENCES** |  - Cyber-Physical and Gentelligent Systems in Manufacturing and Life Cycle. Genetics and Intelligence - Keys to Industry 4.0, 2017, Pages 7-278 http://dx.doi.org/10.1016/B978-0-12-811939-6.00002-9 © 2017 Elsevier Inc.- online video lectures-literature reviews |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to sensors  |
| 2 |  Sensing principles and sensor desing |
| 3 |  Sensor types: Physical and Cehmical Sensors |
| 4 |  Biosensors and applications |
| 5 |  Sensor networks,working principle and design |
| 6 |  MIDTERM I |
| 7 |  Semiconductors and devices |
| 8 |  Optical materials, devices and spectroscopy |
| 9 |  Magnetic materials and devices |
| 10 |  Composit and nanocomposit materials |
| 11 |  MIDTERM II |
| 12 |  Selected sensor applications in manufacturing |
| 13 |  Course review |
| 14 |  Student presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[ ]**  | **[x]**  |

**Prepared by:** Assoc. Prof. Malik KAYA **Date:** 03/02/2022

**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 (English)*** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505602508 | **TITLE** |  Nanomaterials in Sustainable Energy Production |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  |    |    | 3  | 7.5 | COMPULSORY(   ) | ELECTIVE( X ) | English |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | 3 |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (………) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Nanomaterials for solar and fuel cellsNanomaterials for Energy storage and conversionNanomaterials for lithium batteries and hydrogen generationNanomaterials for biofuels |
| **COURSE OBJECTIVES** |  This course aims to teach the usage areas and importance of nanomaterials in sustainable energy production. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Gains knowledge about the use of nanomaterials in energy conversion, storage and biofuel applications. |
| **LEARNING OUTCOMES OF THE COURSE** |  Classifies nanomaterials used in sustainable energy production.Defines the use of nanomaterials in different energy storage and conversion technologies. |
| **TEXTBOOK** |  Li, Q. (Ed.). (2016). Nanomaterials for sustainable energy. Heidelberg: Springer. |
| **OTHER REFERENCES** |  Handbook of Nanostructured Materials and Nanotechnology,. Ed: Hari Singh Nalwa |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Nanomaterials for Energy |
| 3 |  Nanomaterials for Solar Cells |
| 4 |  Nanomaterials for Solar Cells |
| 5 |  Nanomaterials for Energy Conversion |
| 6 |  Nanomaterials for Energy Storage |
| 7 |  Nanomaterials for Fuel Cells  |
| 8 |  Midterm |
| 9 |  Nanomaterials for Rechargeable Lithium Batteries |
| 10 |  Porous nanomaterials to Store Clear Energy Gases |
| 11 |  Nanomaterials for Carbon Capture and Storage |
| 12 |  Nanomaterials for Hydrogen Generation from Solar Water Splitting |
| 13 |  Nanomaterials for the Production of Biofuels |
| 14 |  Nanomaterials Obtained from Renewable Resources and their Applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE *NANOSCIENCE AND NANOTECHNOLOGY* MSc in English 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]**  | **[ ]**  |
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| **LO 5** | Competence to make critical evaluations in the areas of expertise to be developed, to create policies and practices, to offer alternatives and to evaluate the results obtained within the framework of quality processes. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | The ability to use at least one foreign language adequately, ability to communicate and discuss at an advanced level in written, oral and visual at this foreign language | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability of effective usage of the information technologies | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Professional and ethical responsibility awareness | **[ ]**  | **[ ]**  | **[x]**  |

**Prepared by:** Araş. Gör. Dr. Seda Hoşgün **Date:** 31-10-2022

**Signature**: