**NANOSCIENCE AND NANTECHNOLOGY PhD PROGRAMME**

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| **First Year** | | | | | | |
| **I. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#EN17) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 505512602 | [QUANTUM MECHANICS](#EN15) | 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 |
| 505512001 | PhD Seminar | 7.5 | 0+1 | - | **C** | Turkish |
|  | Total of II. Semester | 30 |  | 9 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 21 |  |  |

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| **Second Year** | | | | | | |
| **III. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511801 | PhD PROFICIENCY | 30 | 0+1 | **-** | **C** | Turkish |
|  | Total of III. Semester | 30 |  |  |  |  |
| **IV. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011102 | THESIS PROPOSAL | 30 | 0+1 | **-** | **C** | Turkish |
|  | Total of IV. Semester | 30 |  |  |  |  |
|  | TOTAL OF SECOND YEAR | 60 |  |  |  |  |

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| **Third Year** | | | | | | |
| **V. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | **-** | **C** | Turkish |
|  | Total of V. Semester | 30 |  |  |  |  |
| **VI. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of VI. Semester | 30 |  |  |  |  |
|  | TOTAL OF THIRD YEAR | 60 |  |  |  |  |

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| **Fourth Year** | | | | | | |
| **VII. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | **-** | **C** | Turkish |
|  | Total of VII. Semester | 30 |  |  |  |  |
| **VIII. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 505511803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of VIII. Semester | 30 |  |  |  |  |
|  | TOTAL OF FOURTH YEAR | 60 |  |  |  |  |

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| **Elective Courses** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505511601 | [EXPERIMENTAL METHODS](#EN3) | 7.5 | 3+0 | 3 | E | Turkish |
| 505512604 | [NANO BIOMATERIALS](#EN9) | 7.5 | 3+0 | 3 | E | Turkish |
| 505512605 | [CURRENT APPROACHES IN BIOMIMETIC NANOTECHNOLOGIES](#EN19) | 7.5 | 3+0 | 3 | E | Turkish |
| 505512606 | [TWO DIMENSIONAL NANOMATERIALS](#EN18) | 7.5 | 3+0 | 3 | E | Turkish |
| 505512603 | [NANOCOMPOSITES](#EN7) | 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 (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 analysis  2. 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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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

**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 (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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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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 (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 medicine  2. 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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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

**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** | 505512602 | **TITLE** | Quantum Mechanics |

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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** | | | | | Basic Concepts of Quantum Mechanics, The Mathematical Formalism of Quantum Mechanics, Quantum systems, Mean Values and uncertainty relations, The use of Schrödinger’s equations, Angular momentum and spin, Hydrogen atom | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To instruct the nature of the nano and sub nanosized particles in advanced level | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Ability to explain natural phenomena and analysis  Ability to the sample production and characterization of fabricated samples  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. Shankar, Principles of Quantum Mechanics, Plenum Pres, New York ,1987 Thermal Physics, McGraw-Hill, 1965C.C-Tannoudji, B. Diu, F. Laloe, Quantum Mechanics, Volume I, John Wiley&Sons, New York, 1977 A.S. Davydov, Quantum Mechanics, Pergamon press, New York ,1985 | | | | | | | |
| **OTHER REFERENCES** | | | | | Other books on Quantum physics and quantum mechanics | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Basic Concepts of Quantum Mechanics |
| 2 | The Mathematical Formalism of Quantum Mechanics |
| 3 | The Mathematical Formalism of Quantum Mechanics |
| 4 | Quantum systems |
| 5 | Quantum systems |
| 6 | Midterm Examination 1 |
| 7 | Mean Values and uncertainty relations |
| 8 | Mean Values and uncertainty relations |
| 9 | The use of Schrödinger’s equations |
| 10 | Applications of Schrödinger equations |
| 11 | Midterm Examination 2 |
| 12 | Angular momentum and spin |
| 13 | Hydrogen atom |
| 14 | Hydrogen atom |
| 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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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| **Prepared by :** | Prof. Dr. M. Celalettin BAYKUL | **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** | Joint Course for the Institute | **SEMESTER** | Fall-Spring |

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| **COURSE** | | | |
| **CODE** | 501011101 | **TITLE** | The Scientific Research Methods and Its Ethics |

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

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

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

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** | | | |
| **CODE** | 505512605 | **TITLE** | Current Approaches in Biomimetic Nanotechnologies |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | X | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 20 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 20 |
| Report | | | | | 1 | | 20 |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | In general, information about biomimetics or biomimicry will be given, and in this sense, information will be given about the production and applications of nano materials and technologies, and the mimicry of models, systems and elements in nature in order to solve complex human problems. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Brief and general information about the production, properties and use of materials similar to the models in nature will be given about current approaches in biomimetic nanotechnology, and future perspectives will be discussed. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | 1. To have knowledge about biomimetic nanotechnologies, materials and production.  2. To follow the technology and knowledge that has been made and is being done in the relevant fields.  3. To gain perspective on the problems and innovations of today and the future. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Establishment of biomimetic or biomimicry related knowledge.  2. Analysis of biomimetic technologies.  3. Having the opportunity to apply the learned information during thesis studies or a research.  4. Developing the ability to understand biomimetic technologies and turn towards new approaches. | | | | | | | |
| **TEXTBOOK** | | | | | Noh, I. (Ed.). (2018). Biomimetic medical materials: from nanotechnology to 3D bioprinting. Springer | | | | | | | |
| **OTHER REFERENCES** | | | | | Other related books, articles, presentations and lecture notes. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | General definition of biomimetics, information about mimicry of models, systems and elements in nature. |
| 2 | Biomimetic approaches in nature. |
| 3 | Biomimetics and stem cells |
| 4 | Definition, importance and applications of nanotechnology |
| 5 | Fabrication of nanostructures / engineering |
| 6 | Biomimetic microfluidic models |
| 7 | Midterm |
| 8 | Lab on a chip |
| 9 | Human on a chip models |
| 10 | Biosensor |
| 11 | Biomimicry in 3D printing design |
| 12 | Characterization techniques |
| 13 | Presentations |
| 14 | A general overview |
| 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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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| **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 (PhD)** | **SEMESTER** | Spring |

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| **COURSE** | | | |
| **CODE** | 506612606 | **TITLE** | Two Dimensional Nanomaterials |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | | 2 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | | 1 | | 30 |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Knowing two dimensional nanomaterials, novel nanomaterials such as graphene, graphene oxide, transition metal dichalcogenides, Mxene, their properties, fabrication methods and application areas. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | 1. Graduate students will learn two dimensional nanomaterials 2. Graphene, Graphene oxide, Transition Metal Dichalcogenides and Mxene materials goups will be known. 3. Fabrication methods and application areas of two dimentional nanomaterials will be learned. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Developing novel methods and application areas through the fabrication methods and application areas of two dimentional nanomaterials. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Ability to define two dimensional nanomaterials. 2. Ability to define properties of two dimensional nanomaterials. 3. Ability to explain fabrication methods of two dimensional nanomaterials. 4. Ability to describe the application areas of two dimensional nanomaterials. | | | | | | | |
| **TEXTBOOK** | | | | | Handbook of 2-D Nanomaterials, Ram K. Gupta, CRC Press, 2022. | | | | | | | |
| **OTHER REFERENCES** | | | | | Inorganic Two-dimensional Nanomaterials: Fundamental Understanding, Characterizations and Energy Applications, Changzheng Wu, RCS, 2017. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Two Dimensional Nanomaterials |
| 2 | Graphene, its properties, fabrication methods and applications. |
| 3 | Graphene, its properties, fabrication methods and applications. |
| 4 | Graphene oxide, its properties, fabrication methods and applications. |
| 5 | Transition Metal Dichalcogenides, their properties, fabrication methods and applications. |
| 6 | Transition Metal Dichalcogenides, their properties, fabrication methods and applications. |
| 7 | Midterm Examination |
| 8 | Hexagonal Boron Nitride, its properties, fabrication methods and applications. |
| 9 | Black Phosphorous, silicene, germanene, their properties, fabrication methods and applications. |
| 10 | Metals and Metal Oxides 2-D Nanomaterials their properties, fabrication methods and applications. |
| 11 | Metal Organic Frameworks, their properties, fabrication methods and applications. |
| 12 | Metal Organic Frameworks, their properties, fabrication methods and applications. |
| 13 | Mxenes, their properties, fabrication methods and applications. |
| 14 | Mxenes, their properties, fabrication methods and applications. |
| 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. |  |  |  |
| **LO 2** | Developing novel technique, design and application in nanoscience and nanotechnology or extending the known technique, design and application to different area. |  |  |  |
| **LO 3** | Ability to determine, identify, formulize and solve complex engineering/pure science problems by selecting and applying convenient analysis and modeling methods. |  |  |  |
| **LO 4** | Ability being a leader in solving problems related with nanoscience and nanotechnology. |  |  |  |
| **LO 5** | Publishing at least one paper related with nanoscience and nanotechnology in national and/or international journals and extending the limits of knowledge. |  |  |  |
| **LO 6** | Ability of high level criticizing and proposing alternatives in the professional subjects. |  |  |  |
| **LO 7** | Ability to communicate in written and oral forms in Turkish; advanced proficiency in at least one foreign language. |  |  |  |
| **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. |  |  |  |

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| **Prepared by :** | Assist.Prof.Dr. Şahin Coşkun | **Date:** | 07.11.2022 |

**Signature**: