**METALLURGICAL ENGINEERING PhD PROGRAMME**

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| **First Year** |
| **I. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501001101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#EN15) | 7.5 | 3+0+0 | 3 | **C** | Turkish |
|  | Elective Course-1 | 7.5 | 3+0+0 | 3 | E | Turkish |
|  | Elective Course-2 | 7.5 | 3+0+0 | 3 | E | Turkish |
|  | Elective Course-3 | 7.5 | 3+0+0 | 3 | E | Turkish |
|  | Total of I. Semester  | 30 |  | 12 |  |  |
| **II. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-4 | 7.5 | 3+0+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0+0 | 3 | E | Turkish |
|  | Elective Course-6 | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503812001 | PhD Seminar | 7.5 | 0+1+0 | - | **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 |
| 503811801 | PhD PROFICIENCY | 30 | 0+1+0 | **-** | **C** | Turkish |
|  | Total of III. Semester | 30 |  |  |  |  |
| **IV. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503811802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | Turkish |
| 503811803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | **-** | **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 |
| 503811802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | Turkish |
| 503811803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | **-** | **C** | Turkish |
|  | Total of Fall Semester | 30 |  |  |  |  |
| **VI. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503811802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | Turkish |
| 503811803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+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 |
| 503811802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | Turkish |
| 503811803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | **-** | **C** | Turkish |
|  | Total of VII. Semester | 30 |  |  |  |  |
| **VIII. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503811802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | Turkish |
| 503811803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+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 |
| 503811608 | [ADVANCED CORROSION](#EN14) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503811604 | [ADVANCED PHASE DIAGRAMS](#EN2) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503812602 | [ALLOYS AND COMPOUNS](#EN1) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503811602 | [IMPROVEMENT OF THE MATERIALS PROPERTIES I](#EN3) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503812604 | [IMPROVEMENT OF THE MATERIALS PROPERTIES II](#EN4) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503811603 | [INTERMETALLIC COMPOUNDS I](#EN5) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503812601 | [INTERMETALLIC COMPOUNDS II](#EN6) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503812607 | [KINETICS](#EN7) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503802505 | [MATERIALS IN ENERGY TECHNOLOGIES](#EN9) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503801503 | [MATERIALS SELECTION AND DESIGN](#EN8) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503801504 | [PHASE TRANSFORMATION](#EN10) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503802508 | [STATISTICALS METHODS IN ENGINEERING](#EN11) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503811601 | [STEEL AND HEAT TREATMENTS](#EN12) | 7.5 | 3+0+0 | 3 | E | Turkish |
| 503802506 | [TRIBOLOGY](#EN13) | 7.5 | 3+0+0 | 3 | E | Turkish |

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503812602 | **TITLE** |  ALLOYS AND COMPOUNS  |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 65 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  General description of alloys and compounds, substitutional and interstitial solid solutions, intermetallics, electron compounds and alloy types.  |
| **COURSE OBJECTIVES** |  Giving ability to understand the formation mechanisms of alloys and compounds, teaching how to use them when developing new materials.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of alloys and compounds.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An awareness of the necessity of compounds and alloys in metallurgical engineering.To explain and apllication of compounds, solid solutions and laves phases.An awareness of the necessity of non-ferrous metals in metallurgical enginerring.An understanding of non-ferrous metals and its alloys. |
| **TEXTBOOK** |  Alaşımlar ders notları. İTÜ Kimya-Metalurji Fakültesi. Materials books.Metals Handbook. 10. edition, Vol. 2. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Alloys and compounds |
| 2 |  Substitional solid solutions |
| 3 |  Interstitial solid solutions and compounds |
| 4 |  Electron compounds |
| 5 |  Intermetallics |
| 6 | Midterm Examination 1 |
| 7 |  Laves phases |
| 8 |  Valans and ionic compounds |
| 9 |  Al and its alloys |
| 10 |  Copper and its alloys |
| 11 | Midterm Examination 2 |
| 12 |  Titanium and its alloys |
| 13 |  Magnesium and its alloys |
| 14 |  Zinc alloys, nickel alloys, superalloys |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Prof.Dr. Remzi GÜRLER | **Date:** |        |

**Signature**:

**T.R.**

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**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811604 | **TITLE** |  ADVANCED PHASE DIAGRAMS |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 65 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  In order to complete M.Sc. study, doing literature review, conduction and completion of the theses. Additionally, written and oral report of findings related to field of specialization.  |
| **COURSE OBJECTIVES** |  To learn how to use phase diagrams of ternary or more components in preparation of alloys, in solidification, in heat treatments, in development of new materials and in improvement of existing materials properties.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of specialization.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An understanding of ternary systems containing binary, two and three phases.Applying likidus projectionApplying, analyzing and evaluating the free energy curves understand the drawing of the phase diagrams.An understanding of the importance of the methods of XRD, SEM, TEM on the phase diagrams. |
| **TEXTBOOK** |  West, D:R.F. ternary equilibrium diagrams, MacMillian and Cltd, London, 1965. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Binary phase diagrams |
| 2 |  Introduction to ternary phase diagrams |
| 3 |  One phase ternary systems |
| 4 |  Two phases ternary systems |
| 5 |  Systems containg three phases |
| 6 | Midterm Examination 1 |
| 7 |  Systems containing four phases |
| 8 |  Systems containing more than four phases |
| 9 |  Systems containing more than four phases |
| 10 |  Principles of using liquidus projections |
| 11 | Midterm Examination 2 |
| 12 |  Quaternary phase diagrams |
| 13 |  Drawing of phase diagrams using free energy curves |
| 14 |  The use of XRD, SEM-EDS and TEM techniques in phase diagram construction |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[ ]**  | **[x]**  |
| **Prepared by :**  |  Prof.Dr. Remzi GÜRLER | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811602 | **TITLE** |  IMPROVEMENT OF THE MATERIALS PROPERTIES I |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Grain boundaries and deformation, strengthening from gain boundaries, low-angle grain boundaries, yield-point phenomenon, strain aging, solid-solution strengthening, precipitation hardening, cold-working, straing hardening, annealing of cold-worked metal. |
| **COURSE OBJECTIVES** |  The main aim of the course is to introduce strengthening mechanisms of metallic materials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of specialization.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1. An awareness of the necessity of mechanical properties of materials from the metallurgical engineering viewpoint.2. An awareness of the relation between mechanical properties and microstructure.3. An awareness of the effects of structure defects on material properties.4. To learn the strengthening mechanisims of metallic materials. |
| **TEXTBOOK** |  1. Dieter, G.E. (1988), Mechanical Metallurgy, London: McGrawHill Book Company.2. Kayalı, E.S. ve Ensarı, C. (1986), Metallere Plastik Şekil Verme İlke ve Uygulamaları, İstanbul, İTÜ.3. Çimenoğlu, H. ve Kayalı, E.S. (1991), Malzemelerin Yapısı ve Mekanik Davranışları, İstanbul, İTÜ. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Grain boundaries and its deformation |
| 2 |  Grain boundaries and its deformation |
| 3 |  Strengthening grain boundaries |
| 4 |  Strengthening grain boundaries |
| 5 |  Sub-grains  |
| 6 | Midterm Examination 1 |
| 7 |  Yield-point phenomenon |
| 8 |  Strain aging |
| 9 |  Strain aging |
| 10 |  Solid-solution strengthening |
| 11 | Midterm Examination 2 |
| 12 |  Precipitation hardening |
| 13 |  Cold-working and strain hardening |
| 14 |  Recrsytallization |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Assist. Prof. Dr. Nedret AYDINBEYLİ | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811602 | **TITLE** |  IMPROVEMENT OF THE MATERIALS PROPERTIES II |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Fe-Fe3C Phase diagram, TTT diagrams, diffusion, hardenability, hardening, surface hardening processes and annealing processes. |
| **COURSE OBJECTIVES** |  The main aim of the course is to introduce strengthening mechanisms of metallic materials. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of specialization.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1. An awareness of the necessity of phase diagrams in the metallurgical engineering.2. An awareness of the necessity of TTT diagrams in the metallurgical engineering.3. An awareness of the necessity of deformation hardening in the metallurgical engineering.4. Application of cross-section and surface hardening processes. |
| **TEXTBOOK** |  1. Metals Handbook, V:4.2. Tekin, A. (1984), Çelik ve Isıl İşlemi, İstanbul, İTÜ. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fe-Fe3C Phase diagram |
| 2 |  Fe-Fe3C Phase diagram |
| 3 |  Fe-Fe3C Phase diagram |
| 4 |  TTT diagrams |
| 5 |  Diffusion |
| 6 | Midterm Examination 1 |
| 7 |  Hardenability |
| 8 |  Hardenability |
| 9 |  Hardening (rapid solidification) |
| 10 |  Hardening (rapid solidification) |
| 11 | Midterm Examination 2 |
| 12 |  Surface hardening processes  |
| 13 |  Surface hardening processes |
| 14 |  Annealing processes |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Assist. Prof. Dr. Nedret AYDINBEYLİ | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| --- | --- | --- | --- |
| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811603 | **TITLE** |  INTERMETALLIC COMPOUNDS I |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 65 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  General description of alloys and detailed information about binary intermetallics. |
| **COURSE OBJECTIVES** |  Giving ability to understand the formation mechanisms of intermetallics, teaching how to use them when developing new materials.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of intermetallic compounds.  |
| **LEARNING OUTCOMES OF THE COURSE** |  Having detailed informatin about alloys and intermetallic compounds.An understanding of the production methods of intermetallic compounds.An understanding of the mechanical properties and forming methods of intermetallic compounds.Understands the impact of properties of the intermetallic compounds on production and forming methods.Analyzing the applications of intermetallic compounds.  |
| **TEXTBOOK** |  Metals Handbook. 10. edition, Vol. 10.Metals Handbook. 10. edition, Vol. 2. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  General information on alloys and intermetallics |
| 2 |  General information on alloys and intermetallics |
| 3 |  Production methods |
| 4 |  Production methods |
| 5 |  Mechanical properties |
| 6 | Midterm Examination 1 |
| 7 |  Mechanical properties |
| 8 |  Forming methods |
| 9 |  Welding |
| 10 |  Welding |
| 11 | Midterm Examination 2 |
| 12 |  Corrosion behaviors |
| 13 |  Physical properties |
| 14 |  Applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[ ]**  | **[x]**  |
| **Prepared by :**  |  Prof.Dr. Remzi GÜRLER | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503812601 | **TITLE** |  INTERMETALLIC COMPOUNDS II |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 35 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 65 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Introduction to ternary and quaternary intermetallics, detailed explanation of mechanical properties and corrosion properties. |
| **COURSE OBJECTIVES** |  Giving ability to understand the formation mechanisms of intermetallics, teaching how to use them when developing new materials |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of intermetallic compounds.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An understanding of the intermetallic compounds which contains three and four component.An understanding of the production methods of intermetallic compounds.An understanding of the mechanical properties and forming methods of intermetallic compounds.Understands the impact of properties of the intermetallic compounds on production and forming methods.Analyzing the applications of intermetallic compounds.  |
| **TEXTBOOK** |  Metals Handbook. 10. edition, Vol. 10.Metals Handbook. 10. edition, Vol. 2. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Types of ternary intermetallics |
| 2 |  Types of ternary intermetallics |
| 3 |  Types of quaternary intermetallics |
| 4 |  Production methods |
| 5 |  Mechanical properties |
| 6 | Midterm Examination 1 |
| 7 |  Mechanical properties |
| 8 |  Forming methods |
| 9 |  Welding |
| 10 |  Welding |
| 11 | Midterm Examination 2 |
| 12 |  Corrosion behaviors |
| 13 |  Physical properties |
| 14 |  Applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[ ]**  | **[x]**  |
| **Prepared by :**  |  Prof.Dr. Remzi GÜRLER | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503812607 | **TITLE** |  KINETİCS |

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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 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Diffusion equations, solutions for semi-infinite and finite systems, Boltzman-Matano solution, fast diffusion regions and solutions, kinetics of solid-gas reactions |
| **COURSE OBJECTIVES** |  Advanced understanding of the diffusion equations, solution of the equation with advanced mathematical methods, advanced understanding of the solid-gas reactions in materials science |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1. Identification of the kinetics of the processes in materials science.2. Advanced understanding of the diffusion in materials science.3. Ability to find relation between process characteristics and material property. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Uses the advanced thermo-chemistry in the solutions of materials engineering problems.2. Designs processes by utilizing the kinetics.3. Analyses the relations between process kinetics and materials properties. |
| **TEXTBOOK** |  R.W. Balluffi, S. M. Allen, W. C. Carter, Kinetics of Materials, WILEY, 2005. |
| **OTHER REFERENCES** |  InterP. Shewmon, Diffusion in solids, TMS, 1989. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Solutions and applications of Fick First Law |
| 2 |  Solutions and applications of Fick Second Law, semi-infinite systems |
| 3 |  Solutions and applications of Fick Second Law, finite systems |
| 4 |  Diffusion in multi-phases |
| 5 |  Chemical Diffusion:Boltzman - Matano analyses |
| 6 | Midterm Examination 1 |
| 7 |  Atomistic Theory of Diffusion |
| 8 |  Fast Diffusion Regions |
| 9 |  Ionic Diffusion |
| 10 |  Electro-migration |
| 11 | Midterm Examination 2 |
| 12 |  Solid-gas reaction in Material Science |
| 13 |  Oxidations kinetics in metals |
| 14 |  Kinetics of CVD and PVD |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Prof.Dr. Mustafa ANIK | **Date:** |  20.11.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503801503 | **TITLE** |  MATERIALS SELECTION AND DESIGN |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | X |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  This course includes: Criteria in design, principal characteristics and applications of materials, the materials selection process, case studies.  |
| **COURSE OBJECTIVES** |  The aim of this course is to provide students with the knowledge and skills required to enable them to carry out the selection of suitable materials in engineering and product design. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken this course improve their proficiency on doing research, comparison, analyze and decision-making in the field of materials selection for a given application.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An understanding of the importance of materials selection in the design.An understanding of the structure-property-performance relationship of materials.The ability to decide in a selection of materials for a given applications. The ability to exhibit effective oral and written communication skills. |
| **TEXTBOOK** |  ASM Handbook, Materials Selection and Design, Volume 20, 1997.Ashby, F. M., Materials Selection in Mechanical Design, Elsevier, Butterworth-Heinemann, 2005. |
| **OTHER REFERENCES** |  Fındık, F., Malzeme Seçimi ve Uygulamaları, Sakarya yayıncılık, 365 p., 2008. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  The design process |
| 3 |  Engineering materials and their properties |
| 4 |  Engineering materials and their properties |
| 5 |  Engineering materials and their properties |
| 6 | Midterm Examination 1 |
| 7 |  Materials selection charts |
| 8 |  Materials selection – the basics |
| 9 |  Materials selection – case studies |
| 10 |  Materials selection – case studies |
| 11 | Midterm Examination 2 |
| 12 |  Materials selection – case studies |
| 13 |  Materials selection – case studies |
| 14 |  Materials selection – case studies |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to effectively communicate at an advanced level. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to advanced level of professional and ethical responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 13** | Ability to advanced level of necessity of lifelong learning. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Associate Prof. Dr. Hakan GAŞAN | **Date:** |  14.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503802505 | **TITLE** |  MATERIALS IN ENERGY TECHNOLOGIES |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | X |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  This course introduces the fundamentals principles needed to understand the structure-property-performance relationship of materials used in the energy technologies. It includes materials for production, conversion, storage and transportation of energy with emphasis on solar and hydrogen.  |
| **COURSE OBJECTIVES** |  The aim of this course is to provide students with the general background relating to present and future energy technologies. And also, give an impart the ability to assess critically what materials properties are necessary or need to be developed further for selected energy technologies. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken this course improve their knowledge about the basic properties of advanced materials that can be used in the present and future energy technologies.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An understanding of the future energy technologies. An understanding of the role of materials in the energy technologies.An understanding of the structure-property-performance relationship of materials.The ability to decide in a selection of materials for energy system. The ability to set a relationship between material properties and energy technologies. |
| **TEXTBOOK** |  Dell, R.M., and Rand, D.A.J., Clean Energy, The Royal Society of Chemistry, Cambridge, UK, 323 p., 2004. Sorrell, C.C., Sugihara, S. and Nowotny, J., Materials for Energy Conversion Devices, CRC Press, USA, 433 p., 2005.Metals Handbook |
| **OTHER REFERENCES** |  Energy materials Journal. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Materials priorities for energy |
| 2 |  Lightweight structural materials for transportation |
| 3 |  Green light on energy saving-LED-OLED |
| 4 |  Materials for turbine technology - High-temperature power generation materials |
| 5 |  Materials for turbine technology - Coating technologies |
| 6 | Midterm Examination 1 |
| 7 |  Materials for fuel cell technology |
| 8 |  Hydrogen storage materials-Metal hydrides |
| 9 |  Hydrogen storage materials-Carbon nanotubes-Zeolites-Metal organic frameworks |
| 10 |  Solar energy—photovoltaics |
| 11 | Midterm Examination 2 |
| 12 |  Materials for Wind power-Materials for Water power |
| 13 |  Functional materials for energy generation and conservation-Nuclear fission and fusion materials |
| 14 |  New material options for energy |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to effectively communicate at an advanced level. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Ability to advanced level of professional and ethical responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 13** | Ability to advanced level of necessity of lifelong learning. | **[ ]**  | **[ ]**  | **[x]**  |
| **Prepared by :**  |  Associate Prof. Dr. Hakan GAŞAN | **Date:** |  14.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503801504 | **TITLE** |  PHASE TRANSFORMATION |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm |   |    |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** |    |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  In order to complete M.Sc. study, doing literature review, conduction and completion of the theses. Additionally, written and oral report of findings related to field of specialization.  |
| **COURSE OBJECTIVES** |  To learn how to use phase diagrams of ternary or more components in preparation of alloys, in solidification, in heat treatments, in development of new materials and in improvement of existing materials properties.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of specialization.  |
| **LEARNING OUTCOMES OF THE COURSE** |  An awareness of the necessity of phase transformations in the metallugical engineering.An understanding of how to use the phase transformations in developing new materials.To explain and application of the phase transformations. To explain and application re-crystallization, nucleation and growth kinetics |
| **TEXTBOOK** |  Geçkinli A.E., Faz dönüşümleri, Ders notu İTÜ Kimya-Metalurji Fakültesi. 2. Phase Transformations in metals and alloys. Porter. D.A. and Easterling K.E., Chapmand and Hall, 1996. |
| **OTHER REFERENCES** |  Internet databases. Metals Handbook. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  What is a phase? What phase transformation means. |
| 2 |  Kinetic Theory |
| 3 |  Phase transformations in metals and alloys |
| 4 |  Nucleation |
| 5 |  Diffusional growth theory |
| 6 | Midterm Examination 1 |
| 7 |  Solid state transformation morphology |
| 8 |  Ferrite, cementite, pearlite and bainite transformations |
| 9 |  Martensitic transformations |
| 10 |  Martensitic transformations |
| 11 | Midterm Examination 2 |
| 12 |  Recrystallisiation and growth kinetics |
| 13 |  Aging and its kinetics |
| 14 |  Spiniodal transformation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to effectively communicate at an advanced level. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to advanced level of professional and ethical responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to advanced level of necessity of lifelong learning. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Prof. Dr. Remzi GÜRLER | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503802508 | **TITLE** |  STATISTICALS METHODS IN 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 ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| x |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  Application of Statistics Methods to a engineering problem. |
| **SHORT COURSE CONTENT** |  Importance of Statistics in Engineering, Principles of the Theory of Probability, Frequency Analysis and Parameter Estimation, Engineering of the most important Probability Distribution Functions, Sampling Distributions, Control of Statistical Hypothesis, Regression Analysis and Correlation, Quality Control, Reliability Analysis, Markov Chains, Statistical Analysis of Time Series. |
| **COURSE OBJECTIVES** |  Teaching of Importance of Statistics in Engineering, Principles of the Theory of Probability, Frequency Analysis and Parameter Estimation, Engineering of the most important Probability Distribution Functions, Sampling Distributions, Control of Statistical Hypothesis, Regression Analysis and Correlation, Quality Control, Reliability Analysis, Markov Chains, Statistical Analysis of Time Series. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The above-mentioned statistical techniques taught civil engineers will confront this issue allow them to develop solutions to the problems. |
| **LEARNING OUTCOMES OF THE COURSE** |  The above-mentioned statistical techniques to teach civil engineers. |
| **TEXTBOOK** |  Beyazıt, M., Oğuz, B. Y., Mühendisler İçin İstatistik, Birsen Yayınevi. |
| **OTHER REFERENCES** |  Beyazıt, M., İnşaat Mühendisliğinde Olasılık Yöntemleri, İTÜ, İnşaat Fak. Matbaası, 1996. Çömlekçi, N., İstatistik, İ.T.İ.A., 1978, Eskişehir. Kıcıman, M., Mühendisler için İhtimaller Hesabı ve İstatistiğe Başlangıç, ODTÜ, 1975. Kara, İ., Olasılık, Bilim Teknik Yayınevi, 1983. Akün, F., İstatistik ve Kalite Kontrolü, İTÜ Kütüphanesi, Sayı 923, 1973, İstanbul. Benjamin, J.R. ve Cornell, C.A., Probability, Statistics and Decision for Civil Engineers, 1970. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Importance of Statistics in Engineering |
| 2 |  Principles of the Theory of Probability Principles of the Theory of Probability |
| 3 |  Frequency Analysis and Parameter Estimation |
| 4 |  Engineering of the most important Probability Distribution Functions |
| 5 |  Sampling Distributions |
| 6 | Midterm Examination 1 |
| 7 |  Control of Statistical Hypothesis, |
| 8 |  Regression Analysis and Correlation |
| 9 |  Quality Control |
| 10 |  Reliability Analysis |
| 11 | Midterm Examination 2 |
| 12 |  Markov Chains |
| 13 |  Statistical Analysis of Time Series |
| 14 |  Application of Statistics Methods to a engineering problem. |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 10** | Ability to effectively communicate at an advanced level. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Ability to advanced level of professional and ethical responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to advanced level of necessity of lifelong learning. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Prof. Dr. İlker Bekir TOPÇU | **Date:** |  12.05.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811601 | **TITLE** |  STEEL AND HEAT TREATMENTS |

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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 |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Iron-carbon phase diagram, time-temperature-transformation diagrams, hardenability, annealing, normalization, hardening, tempering, remain austenite, diffusion and surface hardening processes of steels. |
| **COURSE OBJECTIVES** |  The main aim of the course is to introduce steel and its heat treatments. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Graduate students taken the course improve their proficiency on doing research, discussion, comparison, analyze - syntheses and on reporting in the field of specialization.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1. An awereness of the necessity of heat treatments from the metallurgical engineering viewpoint.2. An awareness of the necessity of phase transformations in the metallurgical engineering.3. An awareness of heat treatments effects on the properties.4. Graduate students do the all of heat treatments of steel. |
| **TEXTBOOK** |  1. Çelik ve ısıl işlemi, Adnan Tekin,İTÜ, 1984.2. Metals Handbook, volume 4. |
| **OTHER REFERENCES** |  Internet databases |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fe-C phase diagram. |
| 2 |  Fe-C phase diagram. |
| 3 |  Time-temperature-transformation diagrams. |
| 4 |  Hardenability |
| 5 |  Hardenability |
| 6 | Midterm Examination 1 |
| 7 |  Annealing  |
| 8 |  Normalization |
| 9 |  Hardening |
| 10 |  Hardening |
| 11 | Midterm Examination 2 |
| 12 |  Tempering, remain austenite |
| 13 |  Diffusion and surface hardenening processes of steels |
| 14 |  Diffusion and surface hardenening processes of steels |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Assist. Prof. Dr. Nedret AYDINBEYLİ | **Date:** |        |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503802506 | **TITLE** |  TRIBOLOGY |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( X ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| X | X |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 25 |
| Quiz |   |    |
| Homework | 1 | 25 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  The importance of tribology, adhesion, friction, wear, the determination of friction and wear. |
| **COURSE OBJECTIVES** |  The teaching of the basic mechanizms of the friction and wear, the friction and wear behaviours of the materials and the determination of friction and wear. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The students learn the basic mechanizms of friction and wear, the friction and wear behaviours of materials and determination of friction and wear. |
| **LEARNING OUTCOMES OF THE COURSE** |  The students achieve to necessary knowledge for tribological researchsAn understanding of the improtance of tribology in Metallugry and Materials Engineering.An understanding of basic mechanisms of friction and wear.Analyzing of friction and wear behaviours of materials. |
| **TEXTBOOK** |  Principles and applications of tribology |
| **OTHER REFERENCES** |  Thesis |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  The introduction and importance of tribology |
| 2 |  Adhesion |
| 3 |  Friction |
| 4 |  Friction mechanisms |
| 5 |  Friction of materials |
| 6 | Midterm Examination 1 |
| 7 |  Wear |
| 8 |  Wear mechanisms |
| 9 |  Wear of materials |
| 10 |  Determination of friction and wear |
| 11 | Midterm Examination 2 |
| 12 |  Student presentations |
| 13 |  Student presentations |
| 14 |  Student presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to effectively communicate at an advanced level. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 12** | Ability to advanced level of professional and ethical responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 13** | Ability to advanced level of necessity of lifelong learning. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Assist. Prof. Dr.İbrahim ÇELİKYÜREK | **Date:** |  04.12.2015 |

**Signature**:



**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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| **DEPARTMENT** |  **Metallurgical Engineering (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  503811608 | **TITLE** |  ADVANCED CORROSION |

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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 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Advanced understanding of the electrochemical principles, introduction of the electrochemical techniques, evaluation of the experimental results |
| **COURSE OBJECTIVES** |  To present the principles of advanced corrosion and to provide the ability of the designing of the electrochemical techniques and evaluation of the experimental results. Identification of the problem of corrosion, designing of the related experiments and evaluation of experimental results to take necessary precautions.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  1. Identification of the corrosion in materials science.2. Taking necessary precautions to prevent corrosion in materials science.3. Advanced understanding and applying electrochemical processes. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Uses the advanced informations of electrochemical thermo-dynamic and electrohemical kinetics in the solutions of materials engineering problems.2. Designs electrochemical experiments.3. Chooses and desings materials against corrosion |
| **TEXTBOOK** |  A. J. Bard and L. R. Faulkner, Electrochemical Methods, Wiley, New York (1980).  |
| **OTHER REFERENCES** |  S. Üneri, Korozyon ve önlenmesi, Korozyon derneği yayınları, Ankara (1998). |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Electrochemical thermodynamics |
| 2 |  Electrochemical kinetics |
| 3 |  Passivity |
| 4 |  Corrosion types |
| 5 |  Effect of metallurgical factors |
| 6 | Midterm Examination 1 |
| 7 |  Effect of environmental factors |
| 8 |  Coating against corrosion |
| 9 |  Material selection and design |
| 10 |  Electrochemical techniques |
| 11 | Midterm Examination 2 |
| 12 |  Electrochemical techniques |
| 13 |  Electrochemical techniques |
| 14 |  Electrochemical techniques |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE Metallurgical Engineering PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to apply informations of maths, science and engineering. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Ability to access information in Metallurgical Engineering in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Metallurgical Engineering and their limitations. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability to designing, performing experiment, analyzing and interpreting the experiment results. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Awareness of the new and developing practices in Metallurgical Engineering and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to recognize and formulate problems in Metallurgical Engineering and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to advanced design of a system, material or process in order to provide to desired requirement. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 10** | Ability to advanced proficiency of understanding impacts at global and social context of solution of Metallurgy Engineering | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 11** | Ability to evaluate current scientific, technological, social, cultural and environmental developments; possession of scientific fairness and observation of ethical values and responsibility. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 12** | Ability to use at least one foreign language and to communicate and carry discussions in this language at the advanced level in written, oral or visual forms. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 13** | Ability to do a critical analysis, assessment and synthesis of the ideas and developments in the field of research. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 14** | Ability to present the academic works and their results in all kinds of respectable academic environments and publish them. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Prof.Dr. Mustafa ANIK | **Date:** |  12.04.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**



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

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| **COURSE** |
| **CODE** |        | **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 :**  |  Prof.Dr.Hürriyet Erşahan, Prof.Dr. Ece Turhan, Prof.Dr. Abdullah Alğın, Doç.Dr. Özlem Alpu, Doç.Dr. Fatih Çemrek | **Date:** |  14.06.2016 |

**Signature**: