| Course Name | | | | | | |
|---|---|---|---|---|---|---|
| **FUNDAMENTALS OF MATERIALS SCIENCE** | | | | | | |
| **Code** | **Semester** | **Local Credits** | **ECTS Credits** | **Course Implementation, Hours/Week** | | |
| | | | | **Theoretical** | **Tutorial** | **Laboratory** |
| MET 213E | 3 | 2.5 | 8 | 2 | 1 | - |

| | | | |
|---|---|---|---|
| **Department/Program** | Metallurgical and Materials Engineering | | |
| **Course Type** | Required | **Course Language** | English |
| **Course Prerequisites** | None | | |

| **Course Category by Content, %** | **Basic Sciences** | **Engineering Science** | **Engineering Design** | **General Education** |
|---|---|---|---|---|
| | - | 20 | 60 | 20 |

| | |
|---|---|
| **Course Description** | A general introduction to materials science an emphasizing the importance of materials science for materials engineering, basic classification of material, atomic structure and bonding, bond types, crystal and amorphous structures, miller indices, directions and planes in crystalline structures, imperfections and defects, pure metal, alloy, solid solution concepts, diffusion, mechanical properties of materials and control of microstructure and related engineering standards, introduction to phase diagrams and eutectic alloys, enhancing physical properties by various methods and heat treatments, materials production methods and nowadays engineering materials, engineering materials in the perspective of ferrous alloys, non-ferrous alloys, ceramic, polymer and composites and emphasizing important materials, research topics for future materials |
| **Course Objectives** | 1.To improve students analytical thinking by focusing structure-property- process relations<br>2.Learning basic materials science knowledge and based on this infrastructure recognizing the nowadays engineering materials and their basic production routes, understanding their microstructure and performance relations, selection and safety criteria and related engineering standards<br>3.To encourage students to understand and experience disciplinary engineering in problem solving |
| **Course Learning Outcomes** | The student will<br>1.Understand structure-property-process relations in materials.<br>2.Classify engineering materials<br>3.Describe atomic bonds, orders, crystallography and the effects of bonding in materials<br>4.Describe basic materials properties and the effect of properties on materials<br>5.Explain elastic and plastic deformation mechanism and strengthening mechanisms<br>6.Explain and select test methods to understand the mechanical properties of materials<br>7.Understand the effect of deformation on the microstructural features of materials<br>8.Select materials and processes |
| **Textbook** | Askeland, D.R., “The Science and Engineering of Materials”, Chapman & Hall,1993 |
| **Other References** | 1. Shackleford, J.F., “Introduction to Materials Science for Engineers”, Prentice-Hill<br>2. Callister, W.D., “Fundamentals of Materials Science and Engineering: An Integrated Approach”, 2nd Edition, Wiley Pub.<br>3. Ashby, M., Shercliff, H., Cebon, D., “Materials: Engineering, Science, Processing and Design” |
| **Homework & Projects** | Homework are given for better understanding the lecture after the topic is explained |
| **Laboratory Work** | - |
| **Computer Use** | - |
| **Other Activities** | - |

| **Assessment Criteria** | **Activities** | **Quantity** | **Effects on Grading, %** |
|---|---|---|---|
| | **Midterm Exams** | **1** | **35** |
| | **Quizzes** | | **-** |
| | **Homework** | **3** | **15** |
| | **Projects** | | |
| | **Term Paper/Project** | | |
| | **Laboratory Work** | **-** | |
| | **Other Activities** | | **-** |
| | **Final Exam** | **1** | **50** |

**COURSE PLAN**

| Weeks | Topics | Course Outcomes |
|---|---|---|
| **1** | Introduction to materials science and engineering | 1,2 |
| **2** | Interatomic bonding and atomic structure | 1,2 |
| **3** | Atomic and ionic arrangements | 2,3 |
| **4** | Lattice imperfections | 3 |
| **5** | Atom movements in materials | 2,3 |
| **6** | Mechanical properties of materials | 4,5,6 |
| **7** | Strain hardening and annealing | 5,7 |
| **8** | Solidification and grain size hardening | 5,7 |
| **9** | Solid solution strengthening and isomorphous phase diagrams | 5,7 |
| **10** | Solidification and dispersion strengthening | 5,7 |
| **11** | Precipitation hardening | 5,7 |
| **12** | Dispersion strengthening by phase transformation and heat treatment | 5,7 |
| **13** | Ferrous alloys | 5,7,8 |
| **14** | Non-ferrous alloys | 5,7,8 |

**Relationship between the Course and Metallurgical and Materials Engineering Curriculum**

| | Student Outcomes | Level of Contribution | | |
|---|---|---|---|---|
| | | **1** | **2** | **3** |
| **1** | an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering science and mathematics | **X** | | |
| **2** | an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare as well as global, cultural, social, environmental and economic factors | | | **X** |
| **3** | an ability to communicate effectively with a range of audiences | | | |
| **4** | an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts | | **X** | |
| **5** | an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives | | | |
| **6** | an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgement to draw conclusions | **X** | | |
| **7** | an ability to acquire and apply new knowledge as needed, using appropriate learning strategies | | | **X** |

**1: Little, 2: Partial, 3: Full**

**Course relationships with major elements of the field and material classes**

| | | Level of Contribution | | |
|---|---|---|---|---|
| | | **1** | **2** | **3** |
| **MAJOR ELEMENT OF THE FIELDS** | **STRUCTURE** | | | **X** |
| | **PROPERTIES** | | | **X** |
| | **DESIGN EXPERIMENT/ANALYSE DATA** | | | |
| | **PROCESSING** | | **X** | |
| | **COST/PERFORMANCE** | | | |
| | **QUALITY/ENVIRONMENT** | **X** | | |
| | **DESIGN PROCESS OR PRODUCT** | | **X** | |
| **MATERIAL CLASSES** | **METAL** | | **X** | |
| | **CERAMICS AND GLASS** | | **X** | |
| | **POLYMER** | | **X** | |
| | **COMPOSITES** | | **X** | |
| | **BIOMATERIALS** | | **X** | |

**1: Little, 2: Partial, 3: Full**

| **Prepared by** | **Date** | **Revision #** | **Signature** |
|---|---|---|---|
| Prof. Dr. Gültekin GÖLLER<br>Assoc. Prof. Dr. İpek AKIN KARADAYI | December 2020 | | |