

**Chemical engineering (CHEN) program, “Materials Science and Processing Technologies”  
department**

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| <b>Course Unit Title</b>                             | <b>Principles of engineering materials</b>   |     |
| <b>Course Unit Code</b>                              | ENG 5003   |     |
| <b>Type of Course Unit</b>                           | Elective   |     |
| <b>Level of Course Unit</b>                          | -  |     |
| <b>National Credits</b>                              | 0  |     |
| <b>Number of ECTS Credits Allocated</b>              | 5  |     |
| <b>Theoretical (hour/week)</b>                       | 2  |     |
| <b>Practice (hour/week)</b>                          | 1  |     |
| <b>Laboratory (hour/week)</b>                        | 0  |     |
| <b>Year of Study</b>                                 | -  |     |
| <b>Semester when the course unit is delivered</b>    | -  |     |
| <b>Course Coordinator</b>                            | PhD Fikrat Yusubov   |     |
| <b>Name of Lecturer (s)</b>                          | PhD Fikrat Yusubov   |     |
| <b>Name of Assistant (s)</b>                         | -  |     |
| <b>Mode of Delivery</b>                              | Face to Face, Seminar.   |     |
| <b>Language of Instruction</b>                       | English  |     |
| <b>Prerequisites</b>                                 | -  |     |
| <b>Recommended Optional Program Components</b>       |  |     |
| <b>Course description:</b>                           | This course introduces the fundamental concepts of materials science, focusing on the structure-property relationships of materials and their applications in engineering and technology. Students will explore the characteristics of different materials, including metals, ceramics, polymers, and composites, and understand how atomic and molecular structures influence the mechanical, electrical, thermal, and optical properties of materials. The course also covers modern topics such as nanomaterials, biomaterials, and smart materials.  |     |
| <b>Objectives of the Course:</b>                     | The Materials Science course aims to provide students with a fundamental understanding of the structure, properties, and behavior of materials, including metals, ceramics, polymers, and composites. Students will learn to analyze material properties, interpret phase diagrams, understand the relationship between microstructure and performance, and explore advanced materials like nanomaterials and biomaterials. The course emphasizes sustainable material selection, degradation mechanisms, and practical applications, while developing skills in experimental testing and effective communication of technical concepts. |     |
| <b>Learning Outcomes:</b>                            | By the end of the Materials Science course, students will be able to understand the relationship between material structure and properties, analyze and select materials for engineering applications, interpret phase diagrams, and assess material degradation. They will also gain hands-on experience in material testing, understand the role of advanced materials like nanomaterials, and apply sustainable practices in material usage, while effectively communicating scientific concepts.   |     |
| At the end of the course the student will be able to | Assessment   |     |
| 1  | Understand the relationship between material structure and properties.   | 1,3 |

| 2  | Analyze and evaluate the properties of metals, ceramics, polymers, and composites.  | 1,2,3  |         |
|--|---|--|---------|
| 3  | Interpret phase diagrams and predict material behavior.   | 1,3  |         |
| 4  | Select appropriate materials for various engineering applications.  | 1,3,2  |         |
| 5  | Identify and address material degradation mechanisms.   | 1,2,3  |         |
| 6  | Perform experimental tests and characterize material properties.  | 1,2,3  |         |
| 7  | Apply knowledge of advanced materials like nanomaterials and biomaterials.  | 1,2,3  |         |
| 8  | Incorporate sustainability into material selection and usage.   | 1,3  |         |
| 9  | Communicate materials science concepts effectively in written and oral formats.   | 1,2  |         |
| Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterm Exam              |   |  |         |
| <b>Course's Contribution to Program</b>  |   |  |         |
|  |   | CL   |         |
| 1  | Provides essential knowledge of how material properties affect engineering and scientific applications.                                   | 4  |         |
| 2  | Equips students with the ability to select the right materials for specific engineering tasks based on performance and application needs. | 1  |         |
| 3  | Links theoretical concepts of material structure and behavior to real-world industrial and technological applications.                    | 3  |         |
| 4  | Enhances analytical and critical thinking by applying materials science principles to solve engineering challenges.                       | 5  |         |
| 5  | Introduces modern materials such as nanomaterials and biomaterials, contributing to expertise in emerging fields.                         | 4  |         |
| 6  | Develops hands-on skills in material testing and characterization techniques that are vital for research and industry.                    | 2  |         |
| 7  | Encourages sustainable material selection and the consideration of environmental impacts in engineering decisions.                        | 1  |         |
| 8  | Lays the groundwork for more specialized courses in fields like mechanical, electrical, and materials engineering.                        | 2  |         |
| 9  | Bridges gaps between different engineering disciplines by providing a broad understanding of materials.                                   | 3  |         |
| 10   | Strengthens students' ability to effectively communicate technical information, both in writing and through presentations.                | 2  |         |
| CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High) |   |  |         |
| <b>Course Contents</b>   |   |  |         |
| Week   | Chapters (book)   | Topics   | Exam    |
| 1  | [1]<br>Chapter 2  | Introduction to Materials science                            |         |
| 2  | [1]<br>Chapter 5  | Classification of materials                                  |         |
| 3  | [2]<br>Chapter 3  | The Structure of Crystalline Solids                          |         |
| 4  | [1]<br>Chapter 9  | Imperfections in Solids                                      |         |
| 5  | [1]<br>Chapter 6  | Dislocations   |         |
| 6  | [1]<br>Chapter 6  | Strengthening Mechanisms                                     |         |
| 7  | [1]<br>Chapter 5  | Phase Diagrams. The Iron–Iron Carbide (Fe–Fe <sub>3</sub> C) |         |
| 8  | [1]<br>Chapter 5  | Phase Diagram . Binary Eutectic Systems                      |         |
| 9  |   |  | Midterm |

|   |                  |   |                      |
|---|------------------|---|----------------------|
| 10  | [1]<br>Chapter 7 | Phase Transformations                                   |                      |
| 11  | [1]<br>Chapter 5 | Types of Metal Alloys.                                  |                      |
| 12  | [2]<br>Chapter 3 | Ferrous metals and alloys Non-ferrous metals and alloys |                      |
| 13  | [2]<br>Chapter 3 | Fabrication of Metals. Forming operations               |                      |
| 14  | [2]<br>Chapter 4 | Composite materials                                     |                      |
| 15  | [2]<br>Chapter 5 | Non-metallic materials (Polymers and ceramics)          |                      |
| 16  |                  |   | Final exam           |
| <p><b>Recommended Sources</b></p> <p>TEXTBOOK(S)</p> <p>1.Callister Jr, W.D. and Rethwisch, D.G., 2020. Fundamentals of materials science and engineering: an integrated approach. John Wiley &amp; Sons.</p> <p>2.Ratner, B.D., Hoffman, A.S., Lemons, J.E. and Schoen F.J., (1996).Materials Science, Academic Press, New York.</p> |                  |   |                      |
| <b>Assessment</b>   |                  |   |                      |
| Attendance  | 0%               | At least 75% of class attendance is compulsory          |                      |
| Presentation  | 20%              |   |                      |
| Seminars  | 0%               |   |                      |
| Midterm Exam  | 30%              | Written Exam  |                      |
| Final Exam  | 50%              | Written-Oral Exam                                       |                      |
| Total   | 100%             |   |                      |
| <b>Assessment Criteria</b>  |                  |   |                      |
| Final grades are determined according to the Academic Regulations of Azerbaijan State Oil and Industrial University for Undergraduate Studies   |                  |   |                      |
| <b>Course Policies</b>  |                  |   |                      |
| <ul style="list-style-type: none"> <li>Late assignments will not be accepted unless an agreement is reached with the lecturer.</li> <li>Cheating and plagiarism will not be tolerated. Cheating will be penalized according to the Azerbaijan State Oil and Industrial University General Student Discipline Regulations</li> </ul>   |                  |   |                      |
| <b>ECTS allocated based on Student Workload</b>   |                  |   |                      |
| Activities  | Number           | Duration (hour)   | Total Workload(hour) |
| <b>Course duration in class</b>   | <b>14</b>        | <b>3</b>  | <b>42</b>            |
| Presentation  | 1                | 10  | 10                   |
| Tutorials   | 14               | 1   | 14                   |
| Self-study  | 14               | 4   | 56                   |
| Midterm Examination   | 1                | 3   | 3                    |
| Preparation for midterm exam  | 1                | 10  | 10                   |

|                                  |   |    |               |
|----------------------------------|---|----|---------------|
|                                  |   |    |               |
| Final Examination                | 1 | 3  | 3             |
| Preparation for final exam       | 1 | 15 | 15            |
| <b>Total Workload</b>            |   |    | <b>150</b>    |
| <b>Total Workload/30(h)</b>      |   |    | <b>150/30</b> |
| <b>ECTS Credit of the Course</b> |   |    | <b>5</b>      |