**Sana'a University**
**Faculty of Engineering**
**Mechanical Engineering Department**
**Mechanical Engineering Program**

# 19. Course Specification of Materials Science and Engineering

## I. Course Identification and General Information:

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.** | Course Title: | Materials Science and Engineering. | | | | |
| **2.** | Course Code & Number: | ME111. | | | | |
| **3.** | Credit Hours: | C.H | | | | TOTAL Cr. Hrs. |
| | | Th. | Seminar | Pr | Tu. | |
| | | 2 | - | 2 | - | 3 |
| **4.** | Study level/ semester at which this course is offered: | Second Year-First Semester. | | | | |
| **5.** | Pre –requisite (if any): | Dynamics and Engineering Chemistry. | | | | |
| **6.** | Co –requisite (if any): | None. | | | | |
| **7.** | Program (s) in which the course is offered: | Mechanical Engineering Program. | | | | |
| **8.** | Language of teaching the course: | English Language. | | | | |
| **9.** | Location of teaching the course: | Mechanical Engineering Department. | | | | |
| **10.** | Prepared By: | Associate Prof. Dr. Khalil Al-Hatab | | | | |
| **11.** | Date of Approval: | | | | | |

## II. Course Description:

Material Science and Engineering **(**MSE) course provides a broad introduction to the classification of engineering materials and the interrelationship between structures and properties. The course covers the following topics: atomic structure and bonding; crystal structure, imperfections in solids; diffusion; mechanical properties; strengthening mechanisms and phase diagrams of binary alloys. The aims of this course are to provide the student, with enough knowledge of polymer; ceramic and composite materials and their applications.

| **III. Alignments of the Course Intended learning outcomes (CILOs)** | | **Referenced PILOs** |
|---|---|---|
| **a1** | Characterize knowledge of basic engineering materials. | **A1.** Demonstrate knowledge & understanding of Mathematics, Science, and Engineering relevant to Mechanical Engineering. |

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| **a2** | Classify between the different behaviors of engineering materials throughout finding of desired properties for solving design/process problems. | **A2.** Clarify general principles of design, design techniques, and characteristics of engineering materials and components. |
| **a3** | Describe methodologies of solving engineering problems, data collection and interpretation. | **A4.** Understand knowledge tools and analytical skills in solving problems relevant to Mechanical Engineering |
| **b1** | Construct suitable techniques to choose a suitable material for a particular function based on science, technology and material selection criteria. | **B1**. Apply the principles of engineering, basic science and mathematics to model, analyze, design, and realize physical systems, components or processes in innovative ways. |
| **b2** | Explore creatively; systematic and methodic approaches in problem solving and design throughout finding between the structures and properties of materials and the intended function. | **B2.** Design the Mechanical systems or processes within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability. |
| **c1** | Perform a wide range of analytical tools, techniques, equipment, and software packages pertaining to the discipline. | C**1.** Use the various techniques, skills, equipment and modern engineering tools and methods necessary for Mechanical Engineering practice. |
| **c2** | Apply the available laboratory tests for measuring engineering materials properties to confirm the theoretical results. | **C2.** Conduct experiments; analyze data and present results for various mechanical systems. |
| **c3** | Choose proper materials and process for specific industrial applications based on science and technology. | **C3.** Apply rules and regulations of industrial safety in Mechanical Engineering practices |
| **d1** | Assess to work within the experimental test facility through working teams. | **D1.** Show capability to work in stressful environments, work |

| | | |
|---|---|---|
| | | productively within a team and possess leadership skills. |
| **d2** | Review relevant literature resources and present finding in seminars. | **D4.** Perform searches of literature, use databases, as well as, evaluate information and evidence from various sources. |
| **d3** | Co-operate effectively in writing technical reports. | **D5.** Communicate effectively both orally and in writing technical reports. |

**(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
|---|---|---|
| **a1** Characterize knowledge of basic engineering materials. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |
| **a2** Classify between the different behaviors of engineering materials throughout finding of desired properties for solving design/process problems. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |
| **a3** Describe methodologies of solving engineering problems, data collection and interpretation. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |

**(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
|---|---|---|

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|---|---|---|
| **b1** Construct suitable techniques to choose a suitable material for a particular function based on science, technology and material selection criteria. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |
| **b2** Explore creatively; systematic and methodic approaches in problem solving and design throughout finding between the structures and properties of materials and the intended function. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |

**© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
|---|---|---|
| **c1** Perform a wide range of analytical tools, techniques, equipment, and software packages pertaining to the discipline. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |
| **c2** Apply the available laboratory tests for measuring engineering materials properties to confirm the theoretical results. | Laboratory, seminars | Examinations, laboratory reports, presentations |
| **c3** Choose proper materials and process for specific industrial applications based on science and technology. | Lectures, tutorials laboratory, seminars | Examinations, laboratory reports, homework presentations |

**(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
|---|---|---|
| **d1** Assess to work within the experimental test facility through working teams. | Laboratory | Reports |

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|---|---|---|---|
| **d2** | Review relevant literature resources and present finding in seminars. | Seminars | Presentations |
| **d3** | Co-operate effectively in writing technical reports. | laboratory, seminars | Presentations, Reports |

## IV. Course Content:

### A – Theoretical Aspect:

| Order | Units/Topics List | Learning Outcomes | Sub Topics List | Number of Weeks | Contact hours |
|---|---|---|---|---|---|
| **1.** | Introduction to Materials Science and Engineering. | a1,a2,a3,b1, b2,c3,d2,d3, | – Course Overview and Introduction.<br>– Historical Perspective.<br>– What are Materials Science and Engineering?<br>– Why to Study Materials Science and Engineering?<br>– Classification of Materials.<br>– Advanced Materials.<br>– Modern Materials Needs.<br>– Materials Design and Selection. | 1 | 2 |
| **2.** | Atomic Structure and Interatomic Bonding. | a1,a2,a3,b1, b2,c1,c3,d2, d3, | – Atomic Structure:<br>• Fundamental Concepts.<br>• Effective Team Member.<br>• Electrons in Atoms.<br>• The Periodic Table.<br>– Atomic Bonding in Solids:<br>• Bonding Forces and Energies.<br>• Primary Interatomic Bonds.<br>• Secondary Bonding.<br>• Molecule.<br>– Mixed Bonding:<br>– Relationships Between Arrangements of Atoms and Materials Properties | 1 | 2 |

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|---|---|---|---|---|---|
| **3.** | Crystal Structures of Metals. | a1,a2,a3,b1, b2,c1,c3,d2, d3, | – Fundamental Concepts.<br>– Crystal Structure.<br>– Crystallographic Points, Directions, & Planes.<br>– Crystalline & Non-Crystalline Materials. | 1 | 2 |
| **4.** | Imperfections in Solids. | a1,a2,a3,b1, b2,c1,c3,d2, d3, | – Point Defects in Metals; Ceramics & Polymer.<br>– Specification of Composition.<br>– Linear Defects.<br>– Area Defects.<br>– Volume Defects.<br>– Grain Size Determination. | 1 | 2 |
| **5.** | Diffusion. | a1,a2,a3,b1, b2,c3,d2,d3, | – Diffusion Mechanisms.<br>– Steady-State Diffusion.<br>– Non-Steady State Diffusion.<br>– Factors that Influence Diffusion. | 1 | 2 |
| **6.** | Mechanical Properties. | a1,a2,a3,b1, b2,c3,d2,d3, | – Concepts of Stress and Strain.<br>– Elastic Deformation.<br>– Mechanical Behavior—Metals.<br>– Hardness.<br>– Variability of Material Properties.<br>– Design/Safety Factors. | 1 | 2 |
| **7.** | Deformation and Strengthening Mechanisms. | a1,a2,a3,b1, b2,c3,d2,d3, | – Deformation Mechanisms for Metals<br>– Mechanisms of Strengthening in Metals | 1 | 2 |

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| | | | | | |
|---|---|---|---|---|---|
| | | | – Recovery, Recrystallization, & Grain Growth | | |
| **8.** | Mid-Term Exam. | a1,a2,a3,b1, b2,c1, c2, c3. | – The First 7 Chapters. | 1 | 2 |
| **9.** | Deformation and Strengthening Mechanisms. | a1,a2,a3,b1, b2,c3,d2,d3, | – Deformation Mechanisms for Metals<br>– Mechanisms of Strengthening in Metals<br>– Recovery, Recrystallization, & Grain Growth | 1 | 2 |
| **10.** | Failure. | a1,a2,a3,b1, b2,c3,d2,d3, | – Fracture.<br>– Fatigue.<br>– Creep. | 1 | 2 |
| **11.** | Phase Diagrams. | a1,a2,a3,b1, b2,c3,d2,d3, | – Definitions & Basic Concepts.<br>– Binary Phase Diagrams.<br>– The Iron–Carbon System.<br>– Thermal Processing of Metals. | 2 | 4 |
| **12.** | Ceramic Materials. | a1,a2,a3,b1, b2,c3,d2,d3, | – Types of Ceramics.<br>– Crystal Structure of Ceramics.<br>– Defects & Mechanical Properties of Ceramics.<br>– Processing & Applications of Ceramics. | 1 | 2 |
| **13.** | Polymer Materials. | a1,a2,a3,b1, b2,c3,d2,d3, | – Types of Polymer.<br>– Crystal Structure of Polymer.<br>– Defects & Mechanical Properties of Polymer.<br>– Processing & Applications of Polymer. | 1 | 2 |

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| **14.** | Composites Materials. | a1,a2,a3,b1, b2,c3,d2,d3, | – Particle-Reinforced. Composites.<br>– Fiber-Reinforced Composites.<br>– Structural Composites. | 1 | 2 |
| **15.** | Final Exam. | a1,a2,a3,b1, b2,c1, c2, c3. | All the Chapters. | 1 | 2 |
| **Number of Weeks /and Units Per Semester** | | | | **16** | **32** |

## B - Practical Aspect:

| Order | Tasks/ Experiments | Week Due | Contact hours | Learning Outcomes |
|---|---|---|---|---|
| **1.** | Lab. 1: Introduction. | 2 | 4 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **2.** | Lab. 2: Optical Metallographic Test (1). | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **3.** | Lab. 3: Optical Metallographic Test (2). | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **4.** | Lab. 4: XRD Test. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **5.** | Lab. 5: SEM Test. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **6.** | Practical Mid-Term Exam. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **7.** | Lab. 6: Tension Test. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **8.** | Lab. 7: Hardness Test. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **9.** | Lab. 8: Work Hardening. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **10.** | Lab. 9: Recrystallization. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |

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|---|---|---|---|---|
| **11.** | Lab. 10: Age Hardening. | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **12.** | Review | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **13.** | Practical Final Term Exam | 1 | 2 | a1,a2,a3,b1,b2,c1.c2,c3,d1,d2, d3. |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

## V. Teaching strategies of the course:

- Lectures.
- Tutorials.
- Reports & Sheets.
- Laboratories.
- Seminars.

## VI. Assignments:

| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| **1.** | N/A | N/A | 1st | N/A |
| **2.** | Homework 1. | a1,a2,a3,b1,b2,c3,d2,d3 | 2nd | 0.5 |
| **3.** | Homework 2. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 3rd | 0.5 |
| **4.** | Homework 3. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 4th | 0.5 |
| **5.** | Homework 4. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 5th | 0.5 |
| **6.** | Homework 5. | a1,a2,a3,b1,b2,c3,d2,d3 | 6th | 0.5 |
| **7.** | Homework 6. | a1,a2,a3,b1,b2,c3,d2,d3 | 7th | 0.5 |
| **8.** | Homework 8. | a1,a2,a3,b1,b2,c3,d2,d3 | 8th | 1 |
| **9.** | Homework 9. | a1,a2,a3,b1,b2,c3,d2,d3 | 9th | 1 |
| **10.** | Homework 10-11. | a1,a2,a3,b1,b2,c3,d2,d3 | 10th – 11th | 2 |
| **11.** | Homework 12. | a1,a2,a3,b1,b2,c3,d2,d3 | 12th | 1 |
| **12.** | Homework 13. | a1,a2,a3,b1,b2,c3,d2,d3 | 13th | 1 |
| **13.** | Homework 14. | a1,a2,a3,b1,b2,c3,d2,d3 | 14th | 1 |
| **Total** | | | | **10** |

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## VII. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes |
|---|---|---|---|---|---|
| **1.** | Homework 1 to Homework 14. | 2nd to 15th | 10 | 6.67% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **2.** | Lab. reports 1- 9. | 4th to 13th | 10 | 6.67% | a1,a2,b2,c1.c2,c3,d1,d2,d3 |
| **3.** | Quizzes 1, 2, 3. | 4th ,10th,13th | 10 | 6.67% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **4.** | Mid-Term Exam. | 8th | 20 | 13.33% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **5.** | Practical Mid-Term Exam. | 7th | 10 | 6.67% | a1,a2,b2,c1.c2,c3,d1,d2,d3, |
| **6.** | Practical Final Exam. | 13th | 15 | 10% | a1,a2,b2,c1.c2,c3,d1,d2,d3, |
| **7.** | Final Exam | 16th | 75 | 50% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **Total** | | | **150** | **100%** | |

## VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

**1- Required Textbook(s) (maximum two ).**

1. Callister, W. D., Rethwisch D. G., 2015, Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Ed., Wiley.

**2- Essential References.**

1. Shackelford, J. F., 2014, Introduction to Materials Science for Engineers, 8th Ed., Prentice Hall.
2. Askeland, D. R., Fulay, P. P., Wright, W. J., 2016, The Science and Engineering of Materials, 7th Ed., Cengage Learning.
3. Smith, W. F., 2004, Foundations of Materials Science and Engineering, 3rd Ed., McGraw Hill Higher Education.

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| **3- Electronic Materials and Web Sites *etc*.** | |
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## IX. Course Policies:

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| **1.** | **Class Attendance:**<br>-A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic |
| **2.** | **Tardy:**<br>- For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent. |
| **3.** | **Exam Attendance/Punctuality:**<br>- A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam. |
| **4.** | **Assignments & Projects:**<br>- The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time. |
| **5.** | **Cheating**:<br>- For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty. |
| **6.** | **Plagiarism**:<br>Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university. |
| **7.** | **Other policies:**<br>- Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room<br>- Mobile phones are not allowed in class during the examination.<br>Lecture notes and assignments my given directly to students using soft or hard copy |

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| **Reviewed By** | **Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** |

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| | **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi**<br>**Name of Reviewer from the Department: Assoc. Prof. Dr. Abdul-Malik Momin** |
| | **Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa**<br>**Assoc. Prof. Dr. Ahmed Mujahed**<br>**Asst. Prof. Dr. Munasar Alsubri** |

# 19. Course Plan of Materials Science and Engineering

## I. Information about Faculty Member Responsible for the Course:

| Name of Faculty Member | Assoc. Prof. Dr. Khalil Al-Hatab | Office Hours | | | | | |
|---|---|---|---|---|---|---|---|
| Location& Telephone No. | | SAT | SUN | MON | TUE | WED | THU |
| E-mail | | | 10-12 | | | 12-2 | |

## II. Course Identification and General Information:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Course Title: | Materials Science and Engineering. | | | | |
| 2. | Course Number & Code: | ME111. | | | | |
| 3. | Credit hours: | C.H | | | | TOTAL Cr. Hrs. |
| | | Th. | Seminar | Pr. | Tu. | |
| | | 2 | - | 2 | - | 3 |
| 4. | Study level/year at which this course is offered: | Second Year-First Semester. | | | | |
| 5. | Pre –requisite (if any): | Dynamics and Engineering Chemistry. | | | | |
| 6. | Co –requisite (if any): | None. | | | | |
| 7. | Program (s) in which the course is offered | Mechanical Engineering Program. | | | | |
| 8. | Language of teaching the course: | English Language. | | | | |
| 9. | System of Study: | Semesters | | | | |
| 10. | Mode of delivery: | Lectures and Labs. | | | | |
| 11. | Location of teaching the course: | Mechanical Engineering Department. | | | | |

## III. Course Description:

Material Science and Engineering **(**MSE) course provides a broad introduction to the classification of engineering materials and the interrelationship between structures and properties. The course covers the following topics: atomic structure and bonding; crystal structure, imperfections in solids; diffusion; mechanical properties; strengthening mechanisms

and phase diagrams of binary alloys. The aims of this course are to provide the student, with enough knowledge of polymer; ceramic and composite materials and their applications.

## IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

1. Demonstrate through lectures and laboratory performance, enough knowledge of classes of engineering materials and the interrelationship between structure and physical and mechanical properties of materials.
2. Recognize and state imperfections and atomic movement in solids; deformations and strengthening mechanisms.
3. Pursue further studies in materials processing, select appropriate materials for specific engineering design and related engineering fields.
4. Demonstrate enough knowledge of metals, polymer, ceramic and composite materials and their applications in different fields.
5. Evaluate of the suitable ways for solving the engineering problems related to physical metallurgy and engineering materials.

## V. Course Content:

### A – Theoretical Aspect:

| Order | Units/Topics List | Sub Topics List | Number of Weeks | Contact hours |
|---|---|---|---|---|
| **1.** | Introduction to Materials Science and Engineering. | – Course Overview and Introduction.<br>– Historical Perspective.<br>– What are Materials Science and Engineering?<br>– Why to Study Materials Science and Engineering?<br>– Classification of Materials.<br>– Advanced Materials.<br>– Modern Materials Needs.<br>– Materials Design and Selection. | 1st | 2 |
| **2.** | Atomic Structure and Interatomic Bonding. | – Atomic Structure:<br>• Fundamental Concepts.<br>• Effective Team Member.<br>• Electrons in Atoms.<br>• The Periodic Table.<br>– Atomic Bonding in Solids:<br>• Bonding Forces and Energies.<br>• Primary Interatomic Bonds.<br>• Secondary Bonding.<br>• Molecule.<br>– Mixed Bonding:<br>– Relationships Between Arrangements of Atoms and Materials Properties | 2nd | 2 |
| **3.** | Crystal Structures of Metals. | – Fundamental Concepts.<br>– Crystal Structure.<br>– Crystallographic Points, Directions, & Planes.<br>– Crystalline & Non-Crystalline Materials. | 3rd | 2 |

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|---|---|---|---|---|
| **4.** | Imperfections in Solids. | – Point Defects in Metals; Ceramics & Polymer.<br>– Specification of Composition.<br>– Linear Defects.<br>– Area Defects.<br>– Volume Defects.<br>– Grain Size Determination. | 4th | 2 |
| **5.** | Diffusion. | – Diffusion Mechanisms.<br>– Steady-State Diffusion.<br>– Non-Steady State Diffusion.<br>– Factors that Influence Diffusion. | 5th | 2 |
| **6.** | Mechanical Properties. | – Concepts of Stress and Strain.<br>– Elastic Deformation.<br>– Mechanical Behavior—Metals.<br>– Hardness.<br>– Variability of Material Properties.<br>– Design/Safety Factors. | 6th | 2 |
| **7.** | Deformation and Strengthening Mechanisms. | – Deformation Mechanisms for Metals<br>– Mechanisms of Strengthening in Metals<br>– Recovery, Recrystallization, & Grain Growth | 7th | 2 |
| **8.** | Mid-Term Exam. | – The First 7 Chapters. | 8th | 2 |
| **9.** | Deformation and Strengthening Mechanisms. | – Deformation Mechanisms for Metals<br>– Mechanisms of Strengthening in Metals<br>– Recovery, Recrystallization, & Grain Growth | 9th | 2 |
| **10.** | Failure. | – Fracture.<br>– Fatigue.<br>– Creep. | 10th | 2 |
| **11.** | Phase Diagrams. | – Definitions & Basic Concepts.<br>– Binary Phase Diagrams.<br>– The Iron–Carbon System. | 11th ,12th | 4 |

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|---|---|---|---|---|
| | | – Thermal Processing of Metals. | | |
| **12.** | Ceramic Materials. | – Types of Ceramics.<br>– Crystal Structure of Ceramics.<br>– Defects & Mechanical Properties of Ceramics.<br>– Processing & Applications of Ceramics. | 13th | 2 |
| **13.** | Polymer Materials. | – Types of Polymer.<br>– Crystal Structure of Polymer.<br>– Defects & Mechanical Properties of Polymer.<br>– Processing & Applications of Polymer. | 14th | 2 |
| **14.** | Composites Materials. | – Particle-Reinforced. Composites.<br>– Fiber-Reinforced Composites.<br>– Structural Composites. | 15th | 2 |
| **15.** | Final Exam. | All the Chapters. | 16th | 2 |
| **Number of Weeks /and Units Per Semester** | | | **16** | **32** |

**B - Practical Aspect:**

| Order | Tasks/ Experiments | Number of Weeks | Contact hours |
|---|---|---|---|
| **1.** | Lab. 1: Introduction. | 1st , 2nd | 4 |
| **2.** | Lab. 2: Optical Metallographic Test (1). | 3rd | 2 |
| **3.** | Lab. 3: Optical Metallographic Test (2). | 4th | 2 |
| **4.** | Lab. 4: XRD Test. | 5th | 2 |
| **5.** | Lab. 5: SEM Test. | 6th | 2 |
| **6.** | Practical Mid-Term Exam. | 7th | 2 |
| **7.** | Lab. 6: Tension Test. | 8th | 2 |
| **8.** | Lab. 7: Hardness Test. | 9th | 2 |
| **9.** | Lab. 8: Work Hardening. | 10th | 2 |
| **10.** | Lab. 9: Recrystallization. | 11th | 2 |
| **11.** | Lab. 10: Age Hardening. | 12th | 2 |
| **12.** | Practical Final Term Exam | 13th | 2 |

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|---|---|---|---|
| **13.** | Review | 14th | 2 |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** |

## VI. Teaching strategies of the course:

- Lectures.
- Tutorials.
- Reports & Sheets.
- Laboratories.
- Seminars.

## VII. Assignments:

| No. | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| **1.** | N/A | N/A | 1st | N/A |
| **2.** | Homework 1. | a1,a2,a3,b1,b2,c3,d2,d3 | 2nd | 0.5 |
| **3.** | Homework 2. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 3rd | 0.5 |
| **4.** | Homework 3. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 4th | 0.5 |
| **5.** | Homework 4. | a1,a2,a3,b1,b2,c1,c3,d2,d3 | 5th | 0.5 |
| **6.** | Homework 5. | a1,a2,a3,b1,b2,c3,d2,d3 | 6th | 0.5 |
| **7.** | Homework 6. | a1,a2,a3,b1,b2,c3,d2,d3 | 7th | 0.5 |
| **8.** | Homework 8. | a1,a2,a3,b1,b2,c3,d2,d3 | 8th | 1 |
| **9.** | Homework 9. | a1,a2,a3,b1,b2,c3,d2,d3 | 9th | 1 |
| **10.** | Homework 10-11. | a1,a2,a3,b1,b2,c3,d2,d3 | 10th – 11th | 2 |
| **11.** | Homework 12. | a1,a2,a3,b1,b2,c3,d2,d3 | 12th | 1 |
| **12.** | Homework 13. | a1,a2,a3,b1,b2,c3,d2,d3 | 13th | 1 |
| **13.** | Homework 14. | a1,a2,a3,b1,b2,c3,d2,d3 | 14th | 1 |
| **Total** | | | | **10** |

## VIII. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes |
|---|---|---|---|---|---|

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| | | | | | |
|---|---|---|---|---|---|
| **1.** | Homework 1 to Homework 14. | 2nd to 15th | 10 | 6.67% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **2.** | Lab. reports 1- 9. | 4th to 13th | 10 | 6.67% | a1,a2,b2,c1.c2,c3,d1,d2,d3 |
| **3.** | Quizzes 1, 2, 3. | 4th ,10th,13th | 10 | 6.67% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **4.** | Mid-Term Exam. | 8th | 20 | 13.33% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **5.** | Practical Mid-Term Exam. | 7th | 10 | 6.67% | a1,a2,b2,c1.c2,c3,d1,d2,d3 , |
| **6.** | Practical Final Exam. | 13th | 15 | 10% | a1,a2,b2,c1.c2,c3,d1,d2,d3 , |
| **7.** | Final Exam | 16th | 75 | 50% | a1,a2,a3,b1,b2,c3,d2,d3 |
| **Total** | | | **150** | **100%** | |

## IX. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

**1- Required Textbook(s) (maximum two ).**

1. Callister, W. D., Rethwisch D. G., 2015, Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Ed., Wiley.

**2- Essential References.**

1. Shackelford, J. F., 2014, Introduction to Materials Science for Engineers, 8th Ed., Prentice Hall.
2. Askeland, D. R., Fulay, P. P., Wright, W. J., 2016, The Science and Engineering of Materials, 7th Ed., Cengage Learning.
3. Smith, W. F., 2004, Foundations of Materials Science and Engineering, 3rd Ed., McGraw Hill Higher Education.

**3- Electronic Materials and Web Sites *etc*.**

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## X. Course Policies:

**1. Class Attendance:**

| | |
|---|---|
| | -A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic |
| **2.** | **Tardy:**<br>- For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent. |
| **3.** | **Exam Attendance/Punctuality:**<br>- A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam. |
| **4.** | **Assignments & Projects:**<br>- The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time. |
| **5.** | **Cheating**:<br>- For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty. |
| **6.** | **Plagiarism**:<br>Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university. |
| **7.** | **Other policies:**<br>- Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room<br>- Mobile phones are not allowed in class during the examination.<br>Lecture notes and assignments my given directly to students using soft or hard copy |

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