



**Ahmedabad  
University**

Course	ENR203 Material Science and Engineering	Semester	Monsoon Semester 2024		
Faculty Name(s)	Mayuribala Mangrulkar, Ramya Srinivasan	Contact	mayuribala.mangrulkar@ahduni.edu.in, ramya.srinivasan@ahduni.edu.in		
School	SEAS	Credits	2		
GER Category:		Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP		
Schedule	Section 1	08:00 am to 09:00 am	Mon	01-08-24 to 20-09-24	
		09:00 am to 10:00 am	Mon	01-08-24 to 20-09-24	
		08:00 am to 09:00 am	Wed	01-08-24 to 20-09-24	
		09:00 am to 10:00 am	Wed	01-08-24 to 20-09-24	
	Section 2	08:00 am to 09:00 am	Wed	01-08-24 to 20-09-24	
		09:00 am to 10:00 am	Wed	01-08-24 to 20-09-24	
		08:00 am to 09:00 am	Mon	01-08-24 to 20-09-24	
		09:00 am to 10:00 am	Mon	01-08-24 to 20-09-24	

Prerequisite	Not Applicable OR Applied Physics, Math
Antirequisite	Not Applicable
Corequisite	Not Applicable
Course Description	<p>This course provides the basis for the understanding of structural, mechanical, electrical, optical, and magnetic properties of the Material. It will provide an insight into material science in modern society via studying the advanced materials, understanding the process, and product realization. It helps in understanding how the relationship between materials' structure, processing, and properties influence the product. Laboratory sessions will be devoted to demonstrations and experiments that illustrate the lectures. The course will provide significant insight into the fundamental characteristics of metals, ceramic, nanomaterials, polymers, and nanocomposites.</p> <p>Topics: Introduction to material science and engineering, Atomic structure and bonding in materials, Crystal structure and crystal geometry, Solidification, crystalline imperfection and diffusion in solids, Phase diagrams, engineering alloys, Introduction to ceramic, magnetic materials, polymers, nanomaterials, electronic materials, composite materials.</p>
Course Objectives	<ul style="list-style-type: none"> <li>• To give the students theoretical, and application-based knowledge of the evolution of engineering materials and products.</li> <li>• Review the physics and chemistry in the context of materials science and engineering.</li> <li>• To describe the different types of bonding, types of crystal structures, crystal imperfection, diffusion, and phase diagram analysis and interpretation of X-ray diffractogram.</li> <li>• Understanding the challenges of the manufacturing process.</li> <li>• Understanding the selection of material and shape for a given product.</li> <li>• Understand the basics of material science in depth and apply the knowledge to other advanced courses in chemical and mechanical engineering.</li> </ul>
Learning Outcomes	<p>Upon completion, students should be able to</p> <ul style="list-style-type: none"> <li>• Understand the basics of materials science and engineering (MSE) and get the experience of working in the MSE laboratory which will further strengthen their knowledge.</li> <li>• Identify and calculate the crystal structure of a given material.</li> <li>• Understand the phase diagram, phase transformation in metals, development of microstructure and alteration of mechanical properties.</li> <li>• Understand the relationship between materials structure, processing, and properties,</li> <li>• Investigate the properties of the materials using appropriate materials characterization techniques</li> <li>• Identify, articulate, and solve complex engineering open-ended &amp; real-world problems.</li> <li>• Application of mathematical physics, chemistry, and engineering to Material Science.</li> <li>• Develop the skill to work in a team on the interdisciplinary task.</li> </ul>

Pedagogy	Two lectures a week, Ask questions, Do set Problems, Project-based learning, PPTs, Lecture notes, presentations, quizzes and assignments.
Expectation From Students	<ul style="list-style-type: none"> <li>• Students must be interactive in the classroom.</li> <li>• Students should submit the home assignments on time.</li> <li>• Students should be ready to work in groups.</li> <li>• Students are expected to completely follow the course guidelines.</li> </ul>
Assessment/Evaluation	<ul style="list-style-type: none"> <li>• Other Components: <ul style="list-style-type: none"> <li>◦ Final Exam - 30%</li> <li>◦ Midterm Exam - 20%</li> <li>◦ Presentation - 20%</li> <li>◦ Quiz - 10%</li> <li>◦ Assignment - 20%</li> </ul> </li> </ul>
Attendance Policy	As per Ahmedabad University Policy.
Project / Assignment Details	<ul style="list-style-type: none"> <li>• Students will be asked to do group activities within the course domain and do presentations.</li> </ul>

Course Material	<p>Other Course Material</p> <ul style="list-style-type: none"> <li>• Suggested Textbook:</li> </ul> <p>Materials Science and Engineering: An Introduction , <b>William D. Callister</b> 6<sup>th</sup> edition, John Wiley &amp; Sons.</p> <p>Reference Books / Reading Material</p> <ol style="list-style-type: none"> <li>1. Materials Science and Engineering by William F. Smith, 3<sup>rd</sup> Edition, McGraw- Hill,</li> <li>2. Elements of X-ray Diffraction, B.D. Cullity and S.R. Stock, 3<sup>rd</sup> edition Pearson.</li> <li>3. Materials Science and Engineering - A first Course by V. Raghavan, 5th Edition</li> <li>4. Introduction to Materials Science for Engineers, Shackelford, 7th Edition, Pearson Prentice Hall</li> </ol> <p>,</p> <ul style="list-style-type: none"> <li>• Suggested Textbook:</li> </ul> <p>Materials Science and Engineering: An Introduction , <b>William D. Callister</b> 6<sup>th</sup> edition, John Wiley &amp; Sons.</p> <p>Reference Books / Reading Material</p> <ol style="list-style-type: none"> <li>1. Materials Science and Engineering by William F. Smith, 3<sup>rd</sup> Edition, McGraw- Hill,</li> <li>2. Elements of X-ray Diffraction, B.D. Cullity and S.R. Stock, 3<sup>rd</sup> edition Pearson.</li> <li>3. Materials Science and Engineering - A first Course by V. Raghavan, 5th Edition</li> <li>4. Introduction to Materials Science for Engineers, Shackelford, 7th Edition, Pearson Prentice Hall</li> </ol> <p>,</p> <p>Reference Book</p> <ul style="list-style-type: none"> <li>• Materials Science and Engineering - A first Course, V. Raghavan, 5th Edition.,</li> <li>• Materials Selection in Mechanical Design, Michael F. Ashby · 2017, 5th Edition,</li> <li>• Engineering Materials 1 - An Introduction to Properties, Applications and Design, David R.H. Jones, Michael F. Ashby, Elsevier Science, 2019, 5th illustrated edition.,</li> <li>• Engineering Materials 2 - An Introduction to Microstructures, Processing and Design · Volume 13,, Michael F. Ashby, David R.H. Jones · 2006.,</li> <li>• Materials - Engineering, Science, Processing and Design, Michael F. Ashby, Hugh Shercliff, David Cebon · 2018,</li> </ul>
Additional Information	

## Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
1	Introduction to material science and engineering	Introduction to material science. Evolution of materials, different types of materials & applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
2		Processing methods, manufacturing methods of materials, special treatments.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
3	Material Properties	Mechanical, thermal, electrical, optical, and magnetic properties of materials.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
4	Quiz 1				
5	Crystal structure	Theory of continuum, length scales, electronic structure of atom, types of atomic and molecular bonds. Crystal structures, crystal systems and bravais lattice.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
6		Indexing, miller indices, brag's law, crystal structure determination, single crystal, polycrystalline, amorphous and lamellar point defects, line defects and planar defects.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
7	Quiz 2				
8	Metal and alloys	Classification of metals (ferrous vs nonferrous). Ferrous metal and its alloy, properties and applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
9		Diffusion, Fick's law, solidification, interfaces, grain boundary, Gibbs free energy, Gibbs phase rule.	Reference books	Class Activity - Presentation, Home Activity - Assignments	

10		Introduction to phase diagram, binary isomorphous alloy system, the lever rule, binary eutectic phase diagram. Heat treatment.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
11		Nonferrous metals and their alloys, properties and applications	Reference books	Class Activity - Presentation, Home Activity - Assignments	
12	Polymers	Various polymers, material properties, applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
13		Various polymers, material properties, applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
14		Various polymers, material properties, applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
15		Various polymers, material properties, applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
16	Quiz 3				
17	Composites	Types of composite, constituents of a composite Material.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
18	Textile	Origin and history of textiles, fabrics technical textiles, textile composite materials, applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
19	Ceramics	Ceramic materials, composition, features and properties, examples and applications.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
20		Glass - types of glass and their application. Glass fibres, glass ceramics - types, composition, properties, and application.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
21	Quiz 4				

22	Advance materials	Nanomaterials- examples, synthesis, and characterization	Reference books	Class Activity - Presentation, Home Activity - Assignments	
23		Biomaterials- properties and application.	Reference books	Class Activity - Presentation, Home Activity - Assignments	
24		Energy materials	Reference books	Class Activity - Presentation, Home Activity - Assignments	
25	Quiz 5				
26		Review/Summary			

