

INTRODUCTION TO MATERIALS SCIENCE & ENGINEERING

Course Type	Course Code	Name of the Course	L	T	P	Credits
ESC1	NFME101	Introduction to Materials Science & Engineering	3	0	0	3

Course Objective

To provide the students with basic understanding of the structure-property relationships in materials science and engineering so that they would be able to select and design materials based on performance requirements in their field of engineering.

Learning Outcomes

Undergraduate students of all branches of engineering will learn the basics of structure and properties of engineering materials. Students will have a perspective on development, production, fabrication and application of materials in specific technologies.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Introduction, The evolution of engineering materials, Interactions between atoms: Force and Energy, Interatomic Bonding in materials: Primary and Secondary bonding	3	Students will learn different types of atomic bonds in materials.
2.	Structure of solid, Unit cell, Crystal structures and Bravais lattices, Miller indices of directions and planes, Packing of atoms, Interplanar spacing	4	Students will learn different types of crystal structures and their relationship to properties
3.	Defects and imperfections in solids: Vacancies, Solid solution, Dislocations – edge and screw, Free surfaces, Grain boundaries etc.	7	Students will learn how imperfections in materials affect their property and performance.
4.	Phase diagrams: Phases and components, Use of phase diagrams, Invariant reactions, Fe-C phase diagram, Evolution of microstructure, Phase Transformations: Nucleation and growth, Diffusion: Fick's laws	10	Students will gain the ability to interpret the phase diagram and its uses in prediction and control of material properties.
5.	Mechanical behaviour of materials: Elastic and Plastic deformation, Hardness and Tensile test, Strengthening mechanism, Recovery, Recrystallization and Grain growth	6	Students will learn to measure the mechanical properties and methodologies to tailor them.
6.	Fracture and Fatigue behaviour of materials: Role of cracks, Ductile to brittle transition, Griffith's failure theory, Stress concentration, Fracture toughness, Fatigue failure and its mechanism, Cases of fatigue failures	6	Students will learn the basics of fracture mechanics and prevention from fracture and fatigue.

7.	Mechanical behaviour of materials at high temperature: Creep, Creep mechanism, Deformation mechanism Maps, Corrosion and Degradation of Materials	6	Students will understand the mechanism behind failure due to creep and environmental degradation and developing strategies to mitigate them.
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Text Books:

S. No.	Resource/Book Name	Author(s)/Editor(s)	Publisher
1	Materials Science and Engineering: An Introduction	William D. Callister, David G. Rethwisch	John Wiley & Sons, Inc
2	Materials Science and Engineering: A First Course	V. Raghavan	PHI Learning

Reference Books:

S. No.	Resource/Book Name	Author(s)/Editor(s)	Publisher
1	Materials: Engineering, Science, Processing and Design	M. Ashby, H. Shercliff and D. Cebon	Elsevier

