

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
Integrated B. Tech. + M. Tech. / M.B.A.	Material Science	ME 201	SM+MT+ET 25+25+50
Semester	Credits	L-T-P	Exam.
III	2	2-0-0	3 Hours

Unit - I

Introduction: Historical perspective of Materials Science; Why study properties of materials? Classification of materials:

- a) Advanced and composite Materials;
- b) Modern Materials;
- c) Future materials.

(05 Hours)

Unit - II

Atomic Structure; Inter-atomic Bonding and Structure of Crystalline Solids: Atomic structure; Atomic bonding in solids; Crystal structures; Crystalline and non-crystalline; Materials. Miller indices. Anisotropic elasticity; Elastic behavior of composites; Structure and properties of polymers.

(05 Hours)

Unit - III

Imperfections in Solids and Strengthening Mechanisms: Point defects; Theoretical yield point; Line defects and dislocations; Interfacial defects; Bulk or volume defects; Atomic vibrations; Dislocation and plastic deformation. Strengthening mechanisms in metals; Recovery, recrystallization and grain growth; Precipitation reactions and strengthening.

(05 Hours)

Unit - IV

Mechanical Properties and Diffusion in Metals: Elastic deformation; Plastic deformation; Interpretation of tensile stress-strain curves Yielding under multi-axial stress; Yield criteria and macroscopic aspects of plastic deformation; Property variability and design factors.

Diffusion mechanisms; Steady and non-steady state diffusion; Factors that influence diffusion; Non-equilibrium transformation and microstructure.

(05 Hours)

Unit - V

Phase Diagrams: Equilibrium phase diagrams; Kinetics of nucleation and growth; The iron-carbon system; Phase transformations; Transformation rate effects and TTT diagrams; Microstructure and property changes in iron-carbon system; Heat treatment.

(05 Hours)

Unit - VI

Failure Modes in Materials: Fracture - Ductile and brittle fracture; Fracture mechanics; Impact fracture; Ductile brittle transition; Fatigue - Crack initiation and propagation; Crack propagation rate; Creep; Generalized creep behavior; Stress and temperature effects; Corrosion of metals; Corrosion of ceramics; Degradation of polymers.

(05 Hours)

Recommended Books:

- 1 Fundamentals of Materials Science and Engineering; W. D. Callister; Wiley.
 - 2 Mechanical Metallurgy; G. E. Dieter; Tata Mc Graw Hill (2013).
 - 3 Material Science; V. Raghvan; Prentice Hall of India.
 - 4 Introduction to Materials Science for Engineers; James F. Shackelford; 7th Edition (2009); Pearson Prentice Hall.
 - 5 Materials Science; K. M. Gupta; Umesh Publication.
 - 6 Elements of Material Science & Engineering; Van Vlash; John Wiley & Sons.
 - 7 Material Science; Narula; Tata Mc Graw Hill.
 - 8 Science of Materials Engineering; Srivastava; Srinivasan; New Age Publication.
 - 9 Physical Metallurgy; R. W. Cahn and P. Haasen; North Holland (1996)
 - 10 Structure and Bonding in Crystalline Materials; G. Rohrer; Cambridge University Press (2001).
- Characterization of Materials; Elton N. Kaufmann; 2nd Volume (2003); Set Wiley.