MECHANICAL METALLURGY

Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	FMC303	Mechanical metallurgy	3	0	0	9

Course Objective
Fundamentals of deformation of materials in response to applied forces and introduction to metalworking operations.
Learning Outcomes
• Fundamentals of elastic and plastic deformation. • Strengthening mechanisms in metals. • Failure mechanisms in metals. • Introduction to fracture mechanics. • Introduction to metalworking.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Introduction and Elastic constants (atomistic origin), State of stress in 2D/3D, Transformation of stress, Principal stresses, Mohr Circle, Stress-strain relationships in isotropic and anisotropic materials	8	Stress-strain relationships for elastic behaviour
2.	Tensile test; engineering and true stress-strain curves; ultimate tensile strength; toughness; ductile versus brittle	3	Introduction to the theory of plastic deformation
3.	Concept of Dislocations, Dislocations in the lattice, Burger Vector and its properties, Stress and Strain fields of Dislocations, Energy of Dislocations, Forces on dislocation, Motion of Dislocations, Concept of slip systems, Single crystal slip (critical resolved shear stress - CRSS)	9	Understanding plastic deformation by dislocations
4.	Strain hardening, Solid Solution Strengthening, Precipitation and Dispersion Strengthening, Grain Boundary and Hall-Petch relation	5	Strengthening mechanisms in metals
5.	Introduction to fracture mechanics, Stress concentration, Crack growth criteria (Griffith, Irwin), Mode of deformation, Stress intensity factor, Fracture toughness, Classification of fracture and mechanism	5	Fundamentals, characterization, and mechanisms of fracture
6.	Introduction to Fatigue, Few cases of fatigue failures, SN curve, High and low cycle fatigue, Representation of fatigue data, Fatigue crack propagation, Mechanisms of fatigue fracture	4	Failure of metals by fatigue
7.	Creep: Testing, Mechanisms: Diffusional related, Dislocations related, Grain boundary sliding,	3	Time-dependent deformation of metals at high temperatures
8.	Hardness Tests (Brinell, Rockwell, Vickers, Knoop), Nanoindentation, Impact Testing	2	Methods for measuring mechanical properties
9.	Classification of forming processes: Rolling, forging, extrusion, wire drawing, sheet metal working, formability and forming limit diagram	3	Fundamentals of metalworking
	Total	42	

Text Books:

S. No.	Resource/Book Name	Author(s)/Editor(s)	Publisher
1.	Mechanical Metallurgy	George E. Dieter	McGraw Hill

Reference Books:

S. No.	Resource/Book Name	Author(s)/Editor(s)	Publisher
1.	Mechanical Behaviour of Materials	T. H. Courtney	Waveland Press, Inc
2.	Introduction to Dislocations	D. Hull and D. J. Bacon	Elsevier
3.	Deformation and Fracture of Engineering Materials	R. W. Hertzberg, R. P. Vinci, J. L. Hertzberg	John Wiley & Sons
4.	Elementary Engineering Fracture Mechanics	D. Broek	Springer Dordrecht