Course Type	Course Code	NameofCourse	L	T	P	Credit
DC	NFMC513	Mechanical Behaviour of Materials	3	1	0	4

CourseObjective
The main objective of the course is to understand the mechanism of deformation, strengthening and failure of engineering materials and their response to mechanical loading.
LearningOutcomes
Upon completion of this course, students will be able to: • Solve problems related to elastic and plastic deformation of materials • Appreciate the role of dislocations on mechanical properties of materials • Describe the strengthening mechanisms in materials • Appreciate the failure mechanisms in materials

Unit No.	Topics to be Covered	Lecture Hours	Tutorial Hours	Learning Outcome
1	Introduction: Basic assumptions in strength of materials approach, stress and strain relations, elastic behavior, tensile testing, hardness testing	4	1	Students will be able to solve problems of elastic deformation and stress transformation.
2	Elements of plasticity: Flow curve, strain hardening, yield criteria, strainrate, temperature dependence of flow stress	5	2	Students will earn yield criteria and plastic stress-strain relations with effect of strain rate and temperature
3	Plastic deformation: Slipin crystals, Theoretical strength of a perfect crystal, critical resolved shear stress, properties of dislocations, dislocation motion, forces on dislocations, interaction of dislocations, deformation by twinning	7	2	Students will earn theory of plastic deformation through slip and twin.
4	Strengthening mechanisms: Grain boundary strengthening, solid solution strengthening, precipitate hardening, Strain hardening, Bauschinger effect	6	2	Students will learn various strengthening mechanisms in metallic materials.
5	Fracture: Introduction, types of fracture in metals, theoretical cohesive strength of metals, Griffith theory, stress field near the cracktip, stress intensity as a similitude parameter, the cracktip plastic zone: size and shape in plane stressvs. plain strain, fracture toughness, K1C and size requirements, the energy release rate and R curve concept, compliance, elastic-plastic fracture	6	2	Students will appreciate the effect of flaws/ cracks on mechanical properties of materials.

6	Fatigue: Introduction, short and long cracks, crack nucleation and growth and the stress intensity factor range, Parislaw, fatigue threshold, life estimation: stress-life, strain-life, fractography, factors affecting crack propagation, closure of cracks	6	2	Students will learn failure of materials under cyclic loading conditions and will be able to estimate the life of the component
7	Creep: Introduction, temperature -stress – strain relationships, creep and stress rupture tests, mechanisms of deformation at elevated temperature, deformation mechanism maps, super-plasticity	5	2	Students will learn ways in which mechanical properties change with temperature, and design methods to deal with the changes.
8	Mechanical behavior of non-metallic materials: Ceramics, glasses, polymers, composite materials	3	1	Students will earn the deformation/failure mechanism in non-metallic materials
	Total	**42**	**14**	

TextBooks:

1. Dieter, G.E.,"Mechanical Metallurgy", 3rd Ed., Mc Graw Hill, NewYork,2013.
2. Courtney, T.H., "Mechanical Behavior of Materials", 2nd Ed., McGraw Hill, NewYork,2000.

ReferenceBooks:

1. Meyers,M.A.andChawla,K.K.,"MechanicalBehaviorofMaterials",PrenticeHall.
2. Hull, D.and Bacon, D.J., "Introduction to Dislocations", Pergamon Press, 2008
3. R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 5thEd., John Wiley, New York, 2012
4. W.F.Hosford, Mechanical Behavior of Materials, Cambridge University Press,2005