

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (PRODUCTION ENGINEERING) (28)

ADVANCE MATERIAL TECHNOLOGY

SUBJECT CODE: 2712806

SEMESTER: I

Type of course: Production Engineering (Core II)

Prerequisite: Nil

Rationale: This course provides the knowledge and practice regarding different Material & their behavior. This course gives hands on practice regarding Elastic, Plastic & Failure behaviour. This course gives knowledge for material selection and basic of Composite Materials.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
ESE	OEP	PA			RP					
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Elastic and Plastic Behaviors Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solution hardening, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors - Super plasticity - Deformation of non crystalline material.	6	15
2	Fracture Behavior Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials – Failure Analysis, sources of failure, procedure of failure analysis.	8	20
3	Selection of Materials Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.	6	15
4	Modern Metallic Materials Dual phase steels, Micro alloyed, High strength low alloy (HSLA)	6	15

	steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, bio materials		
5	Non Metallic Materials Plastics, rubber, foams, adhesives and coatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, Al ₂ O ₃ , SiC, Si ₃ N ₄ , CBN and diamond - properties, processing and applications.	6	15
6	Composite materials Reinforced fibers, Particle strengthened and laminar composites-- production techniques of each type, Production of fibers, properties mechanics of composites, manufacturing of metal matrix, Ceramic matrix composite, Carbon-Carbon composite- properties and testing of composite material, areas of application.	8	20

Reference Books:

1. Thomas H. Courtney, " Mechanical Behavior of Materials ", McGraw-Hill, 2000.
2. Charles J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", 3rd Edition, Butterworth-Heinemann, 1977.
3. Flinn, R.A. and Trojan, P.K., "Engineering Materials and their Applications ", (4th Edition), Jaico Publishing, 1999.
4. George E. Dieter, "Mechanical Metallurgy ", McGraw Hill, 1988.
5. Metals Hand Book, Vol.10, "Failure Analysis and Prevention ", (10th Edition), 1994.
6. Willam D. Callister, Jr., "Material Science and Engineering: An introduction", John Wiley & Sons, Inc, 2003.
7. Willam F. Smith, "Principles of Materials Science and Engineering", 3rd edition, McGraw Hill, 2002.

Course Outcome:

After learning this course, the students would be able to acquire different learning out comes in cognitive, psychomotor and affective manner to demonstrate following course outcomes.

1. Understand the elastic and plastic behavior of the material for which it is utilized
2. Fracture Behavior of the material
3. Proper selection of the material for which it is going to utilize.
4. Application of all kind of Industrial Material
5. Performing of Metallurgical Effects on Materials

List of Experiments:

1. Study of corrosion and its effects.
2. Study of microstructure of welded component and HAZ. Macro & Micro Examination.
3. Suitable experiment on Magnetic/ Electrical/Electronic materials.

Open Ended Problems:

1. To study the effect of strain rate on tensile properties and high cycle fatigue behaviour of if steel
2. Investigation of erosion wear of slurry pump material.
3. Processing, Microstructure and Properties of Hybrid Metallic and Ceramic Reinforced Aluminium Composites

4. Synthesis & Characterization of Copper-Graphite Metal Matrix Composite by Powder Metallurgy Route

Major Equipments:

Spectrographic measurement instrument