



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Mechanical Engineering

Course / Subject Code : ME01000521

Course / Subject Name : ADVANCE MATERIAL TECHNOLOGY

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC

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 behaviors. It also gives knowledge for material selection and basic of Composite Materials.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the elastic and plastic behavior of the material for which it is utilized	Understanding
2	Analyze Fracture Behavior of the material	Analyze
3	Proper selection of the material for which it is going to utilize.	Analyze
4	Application of all kind of Industrial Material	Application
5	Performing of Metallurgical Effects on Materials	Evaluate

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Elastic and Plastic Behaviors Elasticity in metals and polymers - Mechanism of plastic deformation,	8	20



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Mechanical Engineering

Course / Subject Code : ME01000521

Course / Subject Name : ADVANCE MATERIAL TECHNOLOGY

	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.		
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.	10	25
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.	7	15
4.	Modern Metallic Materials: Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel- Inter metallics, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, bio materials	6	15
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.	7	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.	7	10



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Mechanical Engineering

Course / Subject Code : ME01000521

Course / Subject Name : ADVANCE MATERIAL TECHNOLOGY

	Total	45	100
--	--------------	-----------	------------

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	30	10	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) 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.

Suggested Course Practical List:

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.

List of Laboratory/Learning Resources Required:

- Spectrographic measurement instrument

* * * * *