

Branch Name:	Mechanical Engineering (Production Technology)
Program Code:	ET209
Course Name:	Advanced Material Technology
Course Code:	2ET2090102T
Pre-requisite Course:	Foundry Technology

Course Objective:

1. This course provides the knowledge and practice regarding different Materials & their behavior.
2. To enhance knowledge of Elastic, Plastic & Failure behavior of Materials.
3. To get acquainted with material selection and basics of Composite Materials.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	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.	02	05
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.	08	30
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.	04	20

4	Modern Metallic Materials: Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallic, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, bio materials	06	25
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.	02	10
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.	02	10

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (e.g., NPTEL) available in the domain/subject. Student is required to make a review- presentation on the work carried out for the same. Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (4) ieeexplore.ieee.org (5) scholar.google.co.in or others of similar repute.

List of References:

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.

Tutorials:

- Students are required to carry out tutorial/assignment work based on subject contents.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the elastic and plastic behavior of the material for different condition on practical application.	2 Understanding 4 Analyze
CLO2	Acquire the fundamentals of fracture behavior and different kind of fracture test of the materials.	3 Applying 4 Analyze

CLO3	Has the capacity to select the material on cost basis and service requirements for different application.	2 Understanding
CLO4	The vast potential of smart materials will encourage students to explore them in detail and to design them for specific applications.	2 Understanding 6 Creating
CLO5	Understand the properties, processing and applications of different non-metallic materials.	2 Understanding 4 Analyze
CLO6	Understand and appreciate the significance of the composites as an important class of materials.	2 Understanding

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H			M		L	M			L				
CLO2	H	L		L	M						L		L	
CLO3	L		M			H	H	H				M	M	
CLO4	H		H			M		L		M		M		H
CLO5	M	M		L	H		H		M					M
CLO6	M	L			M	M	L			L			M	

H: High, M: Medium, L: Low