

Branch Name:	Mechanical Engineering(Production Technology)
Program Code:	ET209
Course Name:	Advanced Engineering Metallurgy
Course Code:	2ET2090401T
Pre-requisite Course:	Material Science

Course Objectives:

1. To understand the importance of Metallurgy and structure – property correlations.
2. To develop a fundamental understanding of mechanical testing.
3. To familiarize with ferrous and nonferrous metallurgy and phase transformations.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
03	03	-	-	03	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Crystal Defects Structure Property Relation: Point, line and area defects, Mechanical properties of Metal and Alloys, Tension test, engineering stress-strain diagram for ductile and brittle materials, compression test. Micro and Nano Hardness, Toughness, Impact Toughness and, fracture toughness testing, Fatigue test, creep test and anisotropy of alloys.	08	20
2	Strengthening Mechanism: Dislocation (elementary concepts only), edge /screw dislocation, partial dislocation, stacking fault, dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure, Strengthening mechanism, strength vs. toughness (ductility), thermo-mechanical processing, micro alloyed steel, ultra-high strength steel, super alloy.	04	05
3	Fracture of Metals: Brittle Fracture, Ductile Fracture, and Factors Leading to Crack Formation, Ductile-brittle Transition in Steels, Fatigue and Creep fracture.	08	25
4	Ferrous Metallurgy: Fe-C diagram, TTT and CCT diagrams, Lever rule and its applications, structure properties of various Fe-C Alloys, Heat Treatment: heat treatments like annealing (recovery, recrystallization and grain growth), normalizing, hardening and	08	25

	tempering. Hardenability of steels, Effect of alloying elements on mechanical properties of steel, alloy steels, tool steels, stainless steels, cast irons. Jominey end quench test.		
5	Non-ferrous Metallurgy: Copper and the Copper-base Alloys, Aluminum and Its Alloys, Other Non-ferrous Metals and Alloys; Ni & Ti alloys.	08	20
6	Metallography & ASTM Standards: Introduction to powder metallurgy & applications, Metallurgical Microscope, Metallography, Color metallography. ASTM standards for mechanical testing, Determination of ASTM grain size number, recent advances in engineering metallurgy.	04	05

Review Presentation:

The student is expected to refer at least two peer reviewed journal papers related to this domain/subject so as to identify issues/challenges and emerging trends. 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 Reference Books:

1. Praymond A. Higgins, Engineering Metallurgy, Part I Applied Physical Metallurgy.
2. G. E. Dieter, Mechanical Metallurgy, Third edition, Tata McGraw-Hill Education.
3. R.E. Reed-Hill, Physical Metallurgy Principles, Cengage Learning.
4. Ghosh A and H.S Ray Principles of Extractive Metallurgy, second edition, New Age International, 1991.
5. William F. Smith, Javed Hashemi, Ravi Prakash, Material Science and Engineering, Fourth edition, McGraw Hill, 2009.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Investigate the relationship between structure of materials and their properties.	2 Understanding 4 Analyze
CLO2	Understand the sub disciplines of metallurgy, its application and structure property correlation.	2 Understanding
CLO3	Develop fundamental understanding of mechanical and metallurgical testing.	3 Applying 6 Creating
CLO4	Develop an understanding about the influence of dislocations and their interactions on the flow behavior of materials and to visualize the importance of dislocations in phenomenon like strain hardening, solid solution strengthening, cold working etc.	2 Understanding 4 Analyze
CLO5	Understand the metallurgy of ferrous and nonferrous materials.	2 Understanding
CLO6	Understand ASTM standards for mechanical testing and its relevance.	2 Understanding 3 Applying

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	M	H		H	M				L					
CLO2	H					L	L			M				
CLO3	M	H		H	H		M	M				L	M	
CLO4	M		L	H	H				M	L	M			H
CLO5	M					M	H	L		M		M	M	
CLO6	M		M	H		M		L		M				M

H:High, M:Medium, L:Low