

Branch Name:	Mechanical Engineering (Production Technology)
Semester/Year:	Semester IV / Second Year
Subject Title:	Advanced Engineering Metallurgy
Subject Code:	1ET2090401
Pre-requisite:	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 Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	05	60	40	30	20	150

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.	10	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, re-crystallization and grain growth), normalizing, hardening and 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.	10	25	
5	Nonferrous Metallurgy: Copper and the Copper-base Alloys, Aluminium and Its Alloys, Other Non-ferrous Metals and Alloys; Ni & Ti alloys.	10	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	
		46	100	

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 (5) ieeexplore.ieee.org (6) scholar.google.co.in or others of similar repute.

Course Outcomes:

The student will be able to

1. Understand the sub disciplines of metallurgy, its application and structure property correlation.
2. Develop fundamental understanding of Mechanical and Metallurgical testing.
3. Understand the Metallurgy of Ferrous and Nonferrous materials.
4. Learn Understand ASTM Standards for mechanical testing and its relevance.

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.

List of Practical:

1. To Understanding of basic fundamentals of material science.
2. To Study and use of metallurgical microscope.
3. Metallographic specimen preparation, mechanical polishing, mounting, and etching.
4. Microstructure of annealed pure metals-iron, copper, lead, zinc aluminum and use of specific etchants.
5. Comparative study of microstructure of annealed steel (Hypo eutectoid, Eutectoid, Hyper Eutectoid) and variation of hardness.
6. To Study about Microstructure of Cast Iron (Gray, White, Nodular).
7. To Study about Microstructure of eutectic alloys Al-Si, Pb-Sn, and Pb-Sb.
8. To Study about Electro polishing.
9. To Study about Microstructure of wrought and annealed single-phase alpha brass & Aluminum.
10. To Study about Recovery, Recrystallisation and Grain growth of cold worked copper.