

**ADVANCED MATERIAL TECHNOLOGY & METALLURGY**  
**Semester II (Production Engineering) SUB CODE: MEPR203**  
**Teaching Scheme (Credits and Hours)**

Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
4	0	2	6	5	3	70	30	20	30	150

**LEARNING OBJECTIVES:**

The objective of this course is

- To learn various aspects of materials selection, their application.

**LESSON PLANNING**

SR.NO	CHAPTER NO	DATE/WEEK	%WEIGTAGE
1	1,2	1 <sup>st</sup> 2 <sup>nd</sup> 3 <sup>rd</sup>	20
2	3	4 <sup>th</sup> 5 <sup>th</sup> 6 <sup>th</sup>	20
3	4,5	7 <sup>th</sup> 8 <sup>th</sup> 9 <sup>th</sup>	20
4	6,7	10 <sup>th</sup> 11 <sup>th</sup> 12 <sup>th</sup>	20
5	8	13 <sup>th</sup> 14 <sup>th</sup> 15 <sup>th</sup>	20

**Total hours (Theory): 60, Total hours (Practical): 30, Total hours: 90**

**DETAILED SYLLABUS**

Chap. No.	Topic
1	<b>Materials and Classification:</b> Solid materials- Classification, Ceramics, composites and metal glasses, selection and application of tool steel, Magnetic alloys, Copper, aluminum and magnesium alloys, Bearing alloys, Super hard materials, Plastics, Alloying techniques-Thermal, mechanical and chemical methods, Power metallurgy techniques, Macro and micro analysis of materials, Macro analysis of ferrous and non ferrous materials, Dendritic structures, Segregation and bonding, Heterogeneity formed through treatment and mechanical working
2	<b>Mechanical Properties:</b> Strengthening mechanism of materials, elements of dislocation theories, Strain hardening, Grain size control, Single crystal growth, Reinforcing fibres for polymers, Composite structure, determination of mechanical properties of materials
3	Dynamic tests, Fracture and toughness tests, Low temperature and high temperature tests, Creep characteristics, Hot hardness tests, Total intragranular cracking and aggressive media, Ceramics and composites, Insulation, Strength and aging of plastics and recrystallisation, Formability, Forgeability and drawability of materials, Powder processing of materials, Ceramic processing, Composite processing, Features controlling machinability of materials, thermal treatment for better mach inability of metals, Universal mach inability index
4	<b>Modern Materials and Alloys:</b> Super alloys-refractory materials, Ceramic and their applications, Low melting alloys, Shape memory alloys, Advanced Composites-Particulate and dispersed composites, Metal matrix and ceramic matrix composites, Carbon-Carbon composites
5	Ti and Ni based alloys for gas turbine applications, Managing and cryogenic steels- Newer materials and their treatment for automobile applications, materials for Naval and nuclear systems. Smart and Nano materials.

6	<b>Polymers :</b> polymerization, Structure and properties of thermoplastics and thermosets, Engineering applications, Property modifications, Mechanical, thermal behaviour of composites with polymer matrix, ceramics glasses
7	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
8	<b>Heat Treatment of ferrous &amp; Non-Ferrous Metals:</b> Iron Carbon phase diagram; TTT diagram; different microstructures; transformations; Annealing, Stress relieving; Spheroidizing; Normalizing; Hardening; Tempering; Austempering; Martempering; Quenching; Quenchants; Quenching media; Surface hardening; Harden ability; Sub-zero treatment; Thermo-mechanical treatment; Chemical Treatment; Tool steel and their heat treatment; cast Iron and their heat treatment. Aluminum and its alloys; Heat treatable and non heat-treatable aluminum alloys; Classification of heat treatment of aluminum alloys; Heat treatment of Aluminum and its alloys; Heat treatment of Magnesium and its alloys; Heat treatment of Titanium and its alloys; Heat treatment of Copper and its alloys; Heat treatment of Nickel and its alloys, Energy Economy in heat treatment

#### LIST OF PRACTICALS

Sr. No.	Practical Content
1	PERFORMANCE OF HARDNESS TEST & HOT HARDNESS TEST ON VARIOUS FERROUS & NON FERROUS METALS
2	PERFORMANCE OF TOUGHNESS TEST
3	PERFORMANCE OF CREEP TEST
4	PERFORMANCE OF STRAIN HARDENING TEST
5	THERMAL ANALYSIS OF FERROUS MATERIALS
6	FABRICATION AND TENSILE TESTING OF MILD STEEL TO JUDGE THE MECHANICAL PROPERTIES
7	MATERIALS SELECTION FOR VARIOUS APPLICATIONS
8	DETERMINATION OF MECHANICAL PROPERTIES OF POLYMER
9	METALLOGRAPHY OF VARIOUS FERROUS & NON FERROUS MATERIALS
10	PERFORMANCE OF FRACTURE TEST & OBSERVATION UNDER SEM

#### INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all units while conducting teaching & examination.
- Attendance is compulsory in lectures and Tutorial.
- Viva Voce will be conducted at the end of the semester of 30 Marks.
- One internal exam of 30 marks is conducted as a part of Mid semester evaluation.

#### STUDENTS LEARNING OUTCOMES:

At the end of the course

- The students will gain an experience in the selection of materials for various applications.

**Reference Books:**

1. Engineering Materials and Applications P. Flinn and P.K. Trojan MIR Publications
2. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava PHI
3. Manufacturing processes for Engineering Materials Serope Kalpakjian Wesley Publishing Co.
4. An introduction to Physical Metallurgy S.H. Avner McGraw Hill
5. Advances in Materials and Their Applications P. Rama Rao Wiley Eastern
6. Mechanical Metallurgy Dieter McGraw Hill
7. Principles of Heat Treatment of Steels R.C. Sharma New Age International (P)
8. Heat Treatment: Principle and Techniques T.V. Rajan, C.P. Sharma

