

Ramgarhia Polytechnic College, Phagwara



Mechanical Engineering Department

Head of Department:	Er. Gaurav Kumar
Name of the Faculty:	Er. Garandeep singh
Discipline:	Mechanical Engineering Department
Semester:	3 rd
Subject:	ENGINEERING MATERIALS
Lesson Plan Duration:	16 Weeks





RATIONALE

Lot of development has taken place in the field of materials. New materials are being developed and it has become possible to change the properties of materials to suit the requirements. Diploma holders in this course are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and non ferrous materials and various heat treatment processes. This subject aims at developing knowledge about the characteristics, testing and usage of various types of materials used in industries.

Learning Outcomes

After undergoing this course, the students will be able to:

- CO1. Distinguish between metals and non metals and ferrous and non ferrous materials.
- CO2. Analyze microstructure and changes in microstructure due to heat treatment.
- CO3. Carryout various heat treatment processes such as annealing, normalizing.
- CO4. Draw and interpret iron-carbon diagram.
- CO5. Classify various types of plastics and rubber.
- CO6. Explain properties and applications of composites, ceramics and smart materials.
- CO7. Select suitable material to be used for various engineering applications

PO \Rightarrow	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO \Downarrow							
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

CO7							
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Syllabus

	Details	Hours
1.	<p>Introduction</p> <p>Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials, Present and future needs of materials, Overview of Biomaterials and semiconducting materials, Various issues of Material Usage-Economical, Environment and Social.</p>	(07hrs)
2.	<p>. Crystallography</p> <p>Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor.</p> <p>Deformation: Overview of deformation behaviour and its mechanisms, behaviour of material under load and stress-strain</p> <p>. Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep</p>	(07hrs)
3.	<p>Metals And Alloys</p> <p>Ferrous Materials: Different iron ores, Raw materials in production of iron and steel, Basic process of iron-making and steel-making, Classification of iron and steel.</p> <p>Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of Grey cast iron and S.G</p> <p>Steels: Steels and alloy steel, Classification of plain carbon steels,</p>	(14 hrs)

	Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on properties of steel, Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel) Non Ferrous Materials: Properties and uses of Aluminium, Copper and Zinc and their alloys	
4.	Heat Treatment Purpose of heat treatment, Solid solutions and its types, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves. Various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening, Hardenability of steels, Selection of case carburizing and induction hardening steels. Types of heat treatment furnaces (only basic idea)	(08hrs)
5.	Plastics Important sources of plastics, Classification-thermoplastic and thermoset and their uses, Various trade names of plastics, Plastic coatings, food grade plastics. Applications of plastics in automobile and domestic use. Rubber classification - Natural and synthetic. Selection of rubber	(03 hrs)
6.	Advanced Materials Composites-Classification, properties, applications Ceramics-Classification, properties, applications Adhesives – Classification, properties and applications Smart materials - properties and applications.	(03 hrs)
7.	Miscellaneous Materials Overview of -Tool and Die materials, Materials for bearing metals, Materials for Nuclear Energy, Refractory materials.	(06hrs)

Reference Books:

1. Text book of Material Science by R.K. Rajput; Katson Pubs, Ludhiana
2. Text book of Material Science by V.K. Manchanda; India Publishing House, Jalandhar.

3. Introduction to Material Science by A.R. Gupta, Satya Prakashan, New Delhi.

4. Material Science by Hazra, Chaudhary

Delivery/Instructional Methodologies

Sr.No.	Description
1.	Chalk and Talk
2.	PowerPoint Presentation

Assessment Methodologies

Sr. No.	Description	Type
1.	Student Assignment	Direct
2.	Test	Direct
3.	Board Examination	Direct
4.	Student Feedback	Direct

Gaps in the syllabus - to meet industry/profession requirements

S.NO.	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
	N/A	N/A	N/A

Topics beyond syllabus/advanced topics

Units	Details	Hours
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N/A	N/A	N/A
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Web Source References

Sr. No.	URL
1.	https://nptel.ac.in/

Lesson Plan

Week	Theory		Practical	
	Lecture Day		Practical Day	02hrs per week
1 st	1 st	Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications	1.	Classification of about 25 specimens of materials/machine parts into (i) Metals and non metals (ii) Metals and
	2 nd			

	3 rd	Classification of materials, Thermal, Chemical properties		alloys
2 nd	4 th	Electrical, Mechanical properties of various materials	2.	(iii) Ferrous and non ferrous metals (iv) Ferrous and non ferrous alloys
	5 th	Present and future needs of materials, Overview of Biomaterials and		
	6 th	semiconducting materials		
3 rd	7 th	Various issues of Material Usage-Economical, Environment and Social	3.	Given a set of specimen of metals and alloys (copper, brass, aluminium, cast iron, HSS, Gun metal)
	8 th	Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals		
	9 th			
4 th	10 th	Number of atoms per unit Cell, Atomic Packing Facto		; identify and indicate the various properties possessed by them.
	11 th	Deformation: Overview of deformation behaviour and		

	12 th	its mechanisms, behaviour of material under load and stress-strain	4.	
5 th	13 th	. Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep	5.	a) Study of heat treatment furnace.
	14 th			
	15 th	Metals And Alloys Ferrous Materials		
6 th	16 th	Different iron ores, Raw materials in production of iron and steel, Basic process of iron-making and steel-making, Classification of iron and steel.	6.	Study of a thermocouple/ pyrometer
	17 th			
	18 th	REVISION		
7 th	19 th	1st Sessional Test (Tentative)	7.	Study of a metallurgical microscope and a specimen polishing machine
	20 th	Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of Grey cast iron and S.G		
	21 st			
8 th	22 nd	Steels: Steels and alloy steel, Classification of plain carbon steels, Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on properties of steel,	8.	REVISION
	23 th			
	24 th			
	25 th	Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)		
	26 th			

9 th	27 th	Non Ferrous Materials: Properties and uses of Aluminium, Copper and Zinc and their alloys	9.	To prepare specimens of following materials for microscopic examination and to Examine the microstructure of the specimens of following materials: i) Brass ii)Copper iii)Grey iv)Malleable v
	28 th			
10 th	29 th	Purpose of heat treatment, Solid solutions and its types, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves	10.	v)Low carbon steel vi)High carbon steel vii) HSS
	30 th			
11 th	31 st	. Various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening, Hardenability of steels	11.	. To anneal a given specimen and find out difference in hardness as a result of annealing
	32 nd			
	33 rd			
12 th	34 th	PTM	12.	REVISION
	35 th	2nd Sessional Test (Tentative)		
	36 th	, , Selection of case carburizing and induction hardening steels. Types of		

		heat treatment furnaces (only basic idea)		
13 th	37 th	Important sources of plastics, Classification-thermoplastic and thermoset	13.	To normalize a given specimen and to find out the difference in hardness as a result of normalizing
	38 th	uses, Various trade names of plastics, Plastic coatings, food grade plastics.		
	39 th	Applications of plastics in automobile and domestic use. Rubber classification - Natural and synthetic. Selection of rubber		
14 th	40 th	Composites-Classification, properties, applications	14	To normalize a given specimen and to find out the difference in hardness as a result of normalizing
	41 st	Ceramics-Classification, properties, applications		
	42 nd	Adhesives – Classification, properties and applications Smart materials - properties and applications		
15 th	43 rd	Overview of -Tool and Die materials	15.	To harden and temper a specimen and to find out the difference in hardness due to tempering.
	44 th			
	45 th	Materials for bearing metals		
16 th	46 th	Materials for Nuclear Energy, Refractory materials.		VIVA
	47 th	REVISION		

	48 th	3rd Sessional Test	16.	
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