

Subject Code: 2ET4000206	Subject Title: Material Science & Technology
Pre-Requisite	--

Rational

The structure-properties relationships of diverse materials are studied in this subject in order to determine how best to utilize them. To comprehend the fundamental idea of choosing and processing metals and materials for their applications, this course focuses on studying various types of ferrous and non-ferrous metals and alloys in terms of their composition, structure, properties, and applications. Nondestructive testing is also covered in this course. The mechanisms, types, and methods for the prevention of corrosion are all covered.

Course objective

1. To comprehend atomic bonding and crystal formations.
2. To comprehend the characteristics of various kinds of ferrous metals and alloys Phase diagram reading.
3. Master the use of a metalworking microscope.
4. The study of fundamental material science principles will aid students in understanding engineering courses where the application of these materials is emphasized.
5. To comprehend the characteristics of various non-ferrous metal and alloy types.
6. List green materials as an improvement over the current one.

TEACHINGANDEXAMINATIONSCHEME:

Teaching Scheme(Hours/ week)				Evaluation Scheme(Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	-	2	4	60	40	20	30

Subject Contents

SR. NO.	TOPIC	TOTAL HOURS	WEIGHTAGE (%)
1.	Introduction to Engineering Materials. - Classification - primary and secondary bond; Types of primary and secondary bonds - Unit cell and space lattice, Simple problems on finding the number of atoms for a unit cell. - The crystal structure for metallic elements: BCC, FCC, and HCP Structure of solids, - Physical, Chemical, Electrical, Electromagnetic and Thermal properties of the material, Solidification of metals.	04	12
2.	Phase Diagrams. - Equilibrium diagrams. i. Concept, definition, and need. ii. Alloys-major elements, an important effect on material properties. iii. Cooling curve concept and method to plot. - Solidification of metals i. Concept. ii. Crystal, grain, grain boundaries, and dendritic solidification. iii. Effect of cooling rate on material properties - Time Temperature Transformation curve- (TTT curve). - Iron carbon equilibrium diagram. i. Concept, need & characteristics. ii. Definition of the terms used.	08	18
3.	Heat Treatment Processes. i. Heat treatment processes. (Annealing, normalizing, carburizing, case hardening, hardening, tempering, sherardizing, nitriding, tempering, stabilizing, etc.). Methods, parameters, and changes in properties. ii. Types of quenching mediums, their properties, and applications	08	18
4.	Metal And Its Alloy - Classification of metals. Ferrous metals i. Classification. ii. Steels-types, composition, properties, applications. (For Plain carbon steel, alloy steel including stainless steel and cast	06	15

	iron.) - Nonferrous metals - Classification. - Types, composition, properties, and applications. (For Copper, copper alloys, Aluminum, and Aluminum alloys.)		
5.	Non-Metallic Materials - Introduction and classification of nonmetallic materials. - Classification of Polymers based on Thermal behavior (Thermoplastics & Thermosetting). - Properties and applications of polymers - Composites. i. Introduction of composite. ii. Characteristics of composites. iii. Types and applications of composites. - Other nonmetallic materials types, properties, and applications, (like rubber, ceramics, refractories.	10	22
6.	Green material - Concept of green material - Sustainable and renewable material in mechanical and allied industries. - Need for advanced materials in the mechanical and automotive sectors. (Electric vehicle, solar panels, battery, etc.	06	15

List of Practical/Experiments

1.	Prepare a report on) 1. Types of bonds, construction, and characteristics of electrovalent, covalent, coordinate hydrogen, and metallic bonds.
2.	Based on any five materials (3 metallic and 2 non-metallic) selected by students, identify their materials of them. Also, state the criteria to identify the material. List the properties of each material. Also judge the main alloying elements and reasons to add them.
3.	Study various heat treatment furnaces and perform hardening processes on ferrous material. Measure the hardness before and after hardening.
4.	Demonstration and study of Metallurgical Microscope.
5.	Prepare micro specimens from ferrous Material and examine them. Also prepare a report on this.
6.	Prepare micro specimens from ferrous and Non-ferrous Material and examine them. Also prepare a report on this.

7.	Visit one relevant industry which has specific heat treatment processes facilities.
8.	Prepare a report on various non-metallic materials classification, properties, and applications. At least four non-metallic materials.
9.	Problem/Project-Based Learning: A group of 4-5 students will identify and collect five machine/product components that are made from different engineering materials and which also failed in their applications. Students will measure and sketch the components (freehand-orthographic views) with dimensions. Students in the group will also discuss the reasons for failure and will noted own the discussion and outcome.

Course Outcome:

The students will be able to:

1. Comprehend the fundamental ideas of material science and metallurgy.
2. Be familiar with the uses of alloys made of ferrous and non-ferrous metals.
3. Research various non-destructive testing approaches.
4. List the scope and restrictions of various items.

List of References:

S.No.	Title of Books	Author	Publication
1.	Materials science,	GBSNarang	Khanna,Publishers,New Delhi.
2.	Materials science and Metallurgy	D.S. Nutt.	S.K Katariyaandsons,Delhi.
3.	Materials science,	R.K. Rajpoot,	LaxmiPublication,DariyaGanj, New Delhi.
4.	Materials science,	R.S. Khurmi,	R.S. SedhaS. Chand.
5.	Physical Metallurgy	SidneyAvner	Tata McGraw-Hill Education.
6.	Material science	O.P. Khanna	Dhanpatrai publication, New Delhi, (2010)

List of Open-Source Software/learning websites:

- <http://vimeo.com/32224002>
- http://www.substech.com/dokuwiki/doku.php?id=ironcarbon_phase_diagram
- <http://www-g.eng.cam.ac.uk/mmg/teaching/typd/>
- <http://www.ironcarbondiagram.com/>
- <http://uk.ask.com/web?q=Who+Discovered+Carbon%3F&qsrc=14097&o=41647924&l=dir>

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Students will able to understand and know about the diverse properties of different material	1 remembering 2 Understanding
CLO2	Students are attaining knowledge of materials and their science & Engineering	1 remembering 2 Understanding
CLO3	Interpret the phase diagrams of materials	2 Understanding
CLO4	Able to investigate the relationship between the structure of materials and their properties with the help of a metallurgical microscope	2 Understanding 3 Applying,
CLO5	Classify and distinguish different types of cast irons, steels, and nonferrous alloys	2 Understanding 3 Applying
CLO6	Describe the concept of heat treatment of steels & strengthening mechanisms	3 Applying, 2 Understanding
CLO7	Students able to understand the powder metallurgy process, types, and manufacturing of composite materials in industrial applications	1 remembering 2 Understanding
CLO8	Application of knowledge relating the composition, structure, and processing of materials to their uses. The field encompasses the spectrum of materials that covers metals, ceramics, polymers, semiconductors, and combinations of materials or composites	1 remembering 2 Understanding

Course Learning Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1	H				M							L	H	L	
CLO2		M											M		
CLO3			M	L									M	M	L
CLO4				H									L		
CLO5	M												M	L	
CLO6	H	M											H	M	
CLO7	H				L								L		L
CLO8	H				L	M	L					L	H	L	L

H:High, M:Medium, L:Low