GUJARAT TECHNOLOGICAL UNIVERSITY

Programme Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering /Mechanical Engineering-(CAD/CAM)/Automobile Engineering/Fabrication Technology/Mechatronics Engineering

Course /Subject Code : DI01000181

Course /Subject Name: Engineering Materials Science

w.e.f. Academic Year:	2024-2025
Semester:	1st
Category of the Course:	BSC-02

Prerequisite:	
Rationale:	The study of engineering materials is fundamental to the field of engineering because it enables engineers to understand the properties and behaviors of various materials, ensuring the selection of the most suitable ones for specific applications. This knowledge is crucial for designing innovative, safe, reliable, and cost-effective structures and products. Additionally, it fosters the development of sustainable solutions by considering the environmental impact and lifecycle of materials. This course is designed to help students grasp the basic concepts of engineering materials and their characteristics, preparing them to select and apply these materials effectively in various engineering contexts.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Compare appropriate material for manufacturing various components.
02	Explain appropriate heat treatment process for various components.
03	Understand classification, properties and applications of various metallic materials.
04	Understand classification, properties and applications of various Non-metallic materials.
05	Explain electrolysis, paints/varnish and corrosion to improve surface properties.
06	Identify green material as an alternative of existing materials.

Teaching and Examination Scheme:

			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction of Engineering Materials** : Classification of Materials • Types of bonds, construction and characteristics of electrovalent, covalent, coordinate, hydrogen and metallic • Structure of solids: Concept of crystalline structure, Structure of metal-unit cell, BCC, FCC and HCP. • Physical, mechanical chemical, electrical, electromagnetic and thermal properties of Material.	**6**	**14**
2.	**Phase Diagrams:** • Solidification of metals: Concept, Crystal, grain and grain boundaries, Effect of cooling rate on material properties solid solution. • Iron carbon equilibrium diagram: Concept, need & characteristics, Definition of the terms used. • Concept of Heat treatment processes.	**7**	**20**
3.	**Metals and Its Alloys :** • Classification of Metals : i. Ferrous Metals: Classification of steel and Cast Ion, It's Properties and Applications ii. Non- Ferrous Metals : Copper, Brass, Bronze, Gun Metals, Aluminum, Wrought and Cast Alloys of Aluminum, It's Properties and Applications • Comparison between Metals and Non-Metals.	**8**	**17**
4.	**Non Metallic Materials :** • Introduction and classification of non- metallic materials. • Properties and Applications: Rubber, Ceramics, Refractories, Insulators,	**8**	**17**

	Abrasives and Adhesives.		
5.	**Electrolytes, oils, paints/ varnish and corrosion :** • Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating; Electro polishing and photo-etching; Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD • Oils. i. Types and properties. ii. Designation methods as per BIS. iii. Applications in Mechanical engineering. • Paints and varnishes. i. Definition and classifications. ii.Surface preparation and coating methods using paints and varnishes. • Corrosion-types and reasons.	**10**	**17**
6.	**Green material:** • Concept of green material • Sustainable and renewable material in mechanical and allied industries. • Need of advanced material in mechanical and automotive sector. (Electric vehicle, solar panels, battery etc)	**6**	**15**
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Sr.No	Unit Title	Teaching Hours	Distribution of Theory Marks (in %)						
			R	U	A	N	E	C	Total Marks
1.	Introduction of Engineering Materials	6	2	4	2	-	2	-	10
2.	Phase Diagrams	7	2	4	4	2	-	2	14
3.	Metals and Its Alloys	8	4	2	2	2	2	-	12
4.	Non Metallic Materials	8	2	4	2	2	2	-	12
5.	Electrolytes, oils, paints/ varnish and corrosion	10	2	4	4	-	-	2	12
6.	Green material	6	2	2	2	2	-	2	10
		45	14	20	16	08	06	06	70
			20%	**28%**	**23%**	**11%**	**9%**	**9%**	**100%**

Where:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asperRevisedBloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Suggested Course Practical List:

Sr No	List of Practical	No of Hours
1	1. State the criteria to identify any five (3metallic and 2 nonmetallic) materials from the selected set of material 2. List properties of each above identified materials. Also identify main alloy in elements and reasons to add	**04**
2	1. Prepare a report on metallurgical examination, its need and importance of microstructure. 2. Write steps for preparation of specimen for microscopic examination. 3. Examine the given specimen by use of metallurgical microscope.	**04**
3	Perform hardening process on ferrous material. Measure the hardness before and after hardening.	**04**
4	Prepare non-ferrous micro specimens and examine them. Also prepare report on this. –Three specimens. (One of copper, second of brass and third of aluminum.)	**04**
5	1. Demonstrate/Study various heat treatment furnaces. 2. Study various Heat treatment processes Annealing, normalizing, hardening, case hardening, tempering, nitriding, Methods, parameters and changes in properties 3.Types of quenching mediums, their properties and applications	**04**
6	Prepare a report on various non-metallic material its classification, properties and application. At least four non-metallic materials	**04**
7	Prepare a report on various Green Material like Electric vehicle, solar panels, battery	**06**
	Total	**30**

List of Laboratory/Learning Resources Required

1. Metallurgical Microscope.
2. Standard specimens.
3. Furnaces to perform heat treatment process.
4. Sorted/required quenching mediums.
5. Hardness tester-to check Rockwell hardness-scales A, B and C.
6. Other hardness testers like sceleroscope, etc.
7. Polishing machine to prepare specimens with necessary consumables.
8. Hand grinder – specifically to prepare specimens and for spark testing.
9. Other consumables.

Suggested Project List:

- **Material Selection:** Choose materials for a specific engineering application
- **Phase Diagram Analysis:** Interpret phase diagrams for material behavior.
- **Microstructural Analysis**: Examine metal microstructures with microscopy.
- **Heat Treatment Effects:** Study the impact of heat treatment on steel.
- **Material Property Testing**: Compare mechanical properties of various metals.
- **Fatigue Testing:** Test metals for fatigue endurance.
- .**Green material :** Study report on green material used in manufacturing industry
- **Smart Materials:** Research and demonstrate smart materials.

Suggested Activity:

-- Prepare report/chart on Cooling curve, Iron-Carbon Phase Diagram and TTT Diagram

-- Prepare report on Heat Treatment Processes and Microstructure Analysis.

References/Suggested Learning Resources:

(a) Books:

S.No.	Author	Title of Books	Publication with place, year and ISBN
1.	GBS Narang	Materials science	Khanna Publishers, New Delhi, (2021),8195028721.

2.	R.K.Rajpoot	Materials science	S.K. Katariya and sons, Dariyaganj, New Delhi. (2013),8185749108
3.	R.S.Khurmi R.S.Sedha	Materials science	S. Chand, Ahmedabad, (2004), 8121901464
4	U.C. Jindal	Materials science and metallurgy	Pearson Education India, Ahmedabad, (2011) 9788131759110
5.	V. Raghavan	Materials science and Engineering	EEE Edition, Prentice Hill, New Delhi, (2015) 9788120350922
6.	R.B.Gupta	Material science and Engineering	Tech India publication, New Delhi, (2018),9351921077
7.	O.P.Khanna	Material science	Dhanpatrai publication, New Delhi, (2010), 8189928317
8.	Sidney Avner	Physical Metallurgy	Tata McGraw-Hill Education, Noida, (2017).0074630067

(b) Open-sources of software and website:

1. https://nptel.ac.in
2. www.vlab.co.in
3. http://en.wikipedia.org/wiki/Materials_science
4. http://www.substech.com/dokuwiki/doku.php?id=iron carbon_phase_diagram

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