

Name of Faculty	:	Faculty of Polytechnic
Name of Program	:	Diploma Engineering (DE)
Course Code	:	2DAE01
Course Title	:	Engineering Materials
Type of Course	:	Basic Engineering (BE)
Year of Introduction	:	2023-24

Prerequisite	:	Zeal to learn the subject
Course Objective	:	<p>Due to globalization manufacturing sector experiencing a vital change over, where the emphasis is on reducing weight, fuel economy, ergonomically design and cost. It is essential to understand various material their composition, properties and applications.</p> <p>Engineering Materials play an important role as the vital tool for solving the problems of material selection and application in the production and manufacturing of equipment/machines, devices, tools, etc. Therefore, an engineering diploma student must be conversant with the properties, composition and behaviour of materials from the point of view of reliability and performance of the product.</p> <p>Subject is concerned with the changes in structure and properties of matter. Many of the processes which are involved to bring out these changes, forms the basis of engineering activities. The study of basic concepts of material science and metallurgy will help the students understanding engineering subjects where the emphasis is laid on the application of these materials.</p>
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Compare appropriate material for manufacturing various components.
	CO2	Explain appropriate heat treatment process for various components.
	CO3	Describe various metal and its alloys based on composition and properties.
	CO4	Understand classification and properties of non-metallic materials and composites,
	CO5	Explain electrolysis, paints and powder material to improve surface properties.
	CO6	Identify green material as an alternative of existing materials.

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
SEE	CIA	SEE	CIA					
3	0	2	4	70	30	30	20	150

Legends: L-Lecture; T-Tutorial/Teacher Guided Theory Practice; P- Practical, C - Credit, SEE - Semester End Examination, CIA - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with CO
1	Engineering Materials Types of bonds, construction and characteristics of electrovalent, covalent, coordinate, hydrogen and metallic, Intermolecular force of attraction, Molecular arrangement in solids, liquid and gases, Structure of solids: Concept of crystalline structure, Structure of metal-unit cell, BCC, FCC and HCP, Examples and properties of metallic structures Physical, mechanical chemical, electrical, electromagnetic and thermal properties of Material.	6	10%	CO1 CO3
2	Phase Diagrams Equilibrium diagrams: Concept, definition and need, Alloys-major elements, reasons to add and important effect on material properties, Cooling curve-concept and method to plot. Solidification of metals: Concept, Crystal, grain, grain boundaries and dendritic solidification, Effect of cooling rate on material properties. Time Temperature Transformation curve- (TTT curve): Need and application, Steps to construct TTT curve Iron carbon equilibrium diagram: Concept, need & characteristics, Definition of the terms used. Heat treatment processes: Heat treatment processes (Annealing, normalizing, carburizing, case hardening, hardening, tempering, spheroidising, nitriding, tempering, stabilizing, etc.). Methods, parameters and changes in properties, Types of quenching mediums, their properties and applications.	10	20%	CO2 CO3

3	<p>Metals And Its Alloys 3.1 Classification of metals. 3.2 Ferrous metals i. Classification. ii. Steels-types, composition, properties, applications. (For Plain carbon steel, alloy steel including stainless steel and cast iron.) 3.3 Nonferrous metals i. Classification. ii. Types, composition, properties and applications. (For Copper, copper alloys, Aluminium and Aluminium alloys.)</p>	8	20%	CO3 CO4
4	<p>Non-Metallic Materials Introduction and classification of non-metallic materials, Classification of Polymers on basis of Thermal behavior (Thermoplastics & Thermosetting), Properties and applications of polymers (like Polyethylene, Polypropylene, Polyvinyl chloride, Teflon, Polystyrene, Phenol formaldehyde, Acrylonitrile, Epoxy resin.), Composites: Introduction of composite, Characteristics of composites, Constituents of composite, Types and applications of composites. Other nonmetallic materials-types, properties and applications, (like rubber, ceramics, refractories, abrasives, adhesives, conductor, electronic circuits/components, insulators etc.).</p>	7	20%	CO3 CO4
5	<p>Electrolytes, oils, paints/ varnish and powder material 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: Types and properties, Designation methods as per BIS, Applications in Mechanical engineering. Paints and varnishes: Definition and classifications, Surface preparation and coating methods using paints and varnishes. Powder metallurgy: Basic concept of powder metallurgy and its applications, merits and demerits, Corrosion-types and reasons.</p>	7	20%	CO5 CO6
6	<p>Green material Concept of green material, Sustainable and renewable material in mechanical and allied</p>	4	10%	CO5 CO6

	industries, Need of advanced material in mechanical and automotive sector. (Electric vehicle, solar panels, battery etc)			
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Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	24	18	28	-	-	-

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

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	Study about the different types of bonds material, its construction and characteristics.	4
2	Study about the various heat treatment process.	4
3	Perform hardening process on ferrous material. Measure the hardness before and after hardening.	4
4	Prepare ferrous micro specimens and examine them. Also prepare report on this :Four specimens. (Plain carbon steel, Alloy steel, Heat-treated steel, Cast iron)	4
5	Prepare non-ferrous micro specimens and examine them. Also prepare report on this: Specimens. (One of copper, second of brass and third of aluminum)	4
6	Prepare a report on various non-metallic materials its classification, properties and application. At least four non-metallic materials.	4
7	Prepare a report on different types of corrosion, identify reason and suggest remedies for each type of corrosion.	2
8	Prepare a report on process equipment's and set up used for any two powder coating process, its working principle and merits.	2

Major Equipment/ Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
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 scleroscope, etc.
7	Polishing machine to prepare specimens with necessary consumables
8	Hand grinder – specifically to prepare specimens and for spark testing.

9	Other consumables.
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Suggested Learning Websites

Sr. No.	Name of Website
1	http://www.substech.com/dokuwiki/doku.php?id=iron_carbon_phase_diagram
2	http://www-g.eng.cam.ac.uk/mmg/teaching/typd/
3	http://www.ironcarbondiagram.com/

Reference Books

Sr. No.	Name of Reference Books
1	Materials science By GBS Narang (Khanna Publishers, New Delhi, (2021),8195028721.)
2	Materials science By R.K.Rajpoot (S.K. Katariya and sons, Dariyaganj, New Delhi. (2013),8185749108)
3	Materials science By R.S.Khurmi R.S.Sedha (S. Chand, Ahmedabad, (2004), 8121901464)
4	Materials science and metallurgy By U.C. Jindal (Pearson Education India, Ahmedabad, (2011) 9788131759110)
5	Materials science and Engineering By V. Raghavan (EEE Edition, Prentice Hill, New Delhi, (2015) 9788120350922)
6	Material science and Engineering By R.B.Gupta (Tech India publication, New Delhi, (2018),9351921077)
7	Material science By O.P.Khanna (Dhanpatrai publication, New Delhi, (2010), 8189928317)
8	Physical Metallurgy By Sidney Avner (Tata McGraw-Hill Education, Noida, (2017).0074630067)