

Subject Code: 1ET4000209	Subject Title: Material Science & Metallurgy
Pre-Requisite	--

Rationale:

Engineering Materials play an important role as the vital tool for solving the problems of material selection and application in the construction and manufacturing of equipment/machines, devices, attachments, tools, etc. Right selection of materials adds to the economy, working, quality and life of all mechanical related devices and elements. A diploma holder must be conversant with the properties, composition, availability, cost and applications (emerging in the fields of medical, automobile, energy, ship building, space, air crafts, mining, cement industries, pharmaceutical machineries, plastic molding machineries, communication, information technology, computer engineering, construction machineries, offshore drilling, etc.) of materials used for construction/fabrication/ tooling.

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.

Course Objective: -

1. Solving the problems of material selection and application in the construction and manufacturing of equipment/machines, devices, attachments, tools, etc.
2. Right selection of materials adds to the economy, working, quality and life of all mechanical related devices and elements.
3. Reading phase Diagrams.
4. Operate Metallurgical microscope.
5. The study of basic concepts of material science will help the students understanding engineering subjects where the emphasis is laid on the application of these materials.

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
4	-	2	5	60	40	20	30

Subject Contents			
SR. NO.	TOPIC	TOTAL HOURS	WEIGHTAGE (%)
1.	Introduction on Engineering Materials. Structure of solids, Physical, Chemical, Electrical, Electromagnetic and Thermal properties of material, Solidification of metals.	06	10
2.	Equilibrium Diagram(Phase Diagrams). Equilibrium diagrams (Concept, definition and need, Solid solution-definition, properties, Alloys-major elements, Reasons to add and important effect on material properties) Time Temperature Transformation curve- (TTT curve), Iron carbon equilibrium Diagram	10	18
3.	Heat treatment processes. Definition, Objectives and application of Heat treatment Different types of Heat treatment Processes like Annealing, Normalizing, Hardening and Tempering, Full Hardening and case Hardening methods with its Purposes and Applications Quenching Medium	10	18
4.	Metallurgical Microscope. Metallographic examination and microstructures need and importance, Principle & working of metallurgical microscope. Preparation of specimen for microscopic examinations	04	07
5.	Metals and Its alloys. Classification of metals, (Classification, Steels-types, composition, properties, applications, Designation and coding methods according to BIS for plain & alloy steel and cast iron, Designation and coding), Non-ferrous metals (Classification, Types, composition, properties and applications	12	20

6.	Non-metallic materials: Classification and applications of non-metallic materials Classification and Applications Of Plastic Properties and applications of Polymers. Types, Properties and Applications of Refractory materials, insulation materials, Abrasive materials and Adhesive materials	08	15
7.	Powder metallurgy Basic concept of powder metallurgy and its Properties Applications, merits and demerits of Powder Metallurgy. Manufacturing process of Powder. Powder Coatings Process	06	12

Course Outcome:

The students will be able to

1. Understand the basic concept of Material Science and Metallurgy.
2. Know about the ferrous and non-ferrous metals and alloys and their applications.
3. Explore different non-destructive testing methods.
4. Identify the Scope and limitations of different materials.

List of Practical/ Experiments

1.	Based on any five material (3 metallic and 2 non-metallic) selected by student, identify materials of them. Also state the criteria to identify the material. List properties of each material. Also judge main alloying elements and reasons to add them.
2.	Study of various heat treatment furnaces, and Perform hardening process on ferrous material. Measure the hardness before and after hardening.
3.	Demonstration and study of Metallurgical Microscope.
4.	Prepare micro specimens from ferrous Material and examine them. Also prepare report on this.
5.	Prepare micro specimens from Non-ferrous Material and examine them. Also prepare report on this.
6.	Visit one relevant industry which have specifically heat treatment processes facilities.
7.	a. Each student will explain at least one diagram (assigned by teacher-may be part of iron-carbon diagram, TTT curve for specific material, etc.) to all batch colleagues. b. Each student will share his/her student's activities outcome. He/she will also share the experience for the student activities he/she has carried out.

8.	Problem/project Based Learning: Group of 4-5 students will identify and collect five machine / product components which are made from different engineering materials and which are also failed in their applications. Students will measure and sketch the components (free hand-orthographic views) with dimensions. Students in group will also discuss the reasons of failure and will note down the discussion and outcome.
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List of References:

1. Materials science, GBS Narang Khanna, Publishers, New Delhi.
2. Materials science and metallurgy D.S. Nutt S.K. Katariya and sons, Delhi.
3. Materials science, R.K. Rajpoot, Laxmi Publication, Dariya ganj, New Delhi.
4. Materials science, R.S. Khurmi, R.S. Sedha S. Chand.
5. Physical Metallurgy Sidney Avner Tata McGraw-Hill Education v.

List of Software/Learning Websites:

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