GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Chemical Engineering

Course / Subject Code : DI01C05021 (Only for C to D Students)

Course / Subject Name : Material Science and Technology

w. e. f. Academic Year:	2024-25
Semester:	1st
Category of the Course:	ESC-02

Prerequisite:	NA
Rationale:	The industries related to chemical manufacturing requires study of various classes of materials like metals and alloys, ceramics, coatings, insulating, polymeric materials and lubricants for different applications. This study has importance towards the understanding of properties of materials for construction of various equipment's and piping systems. Properties of materials affect the life and performance of equipment to the large extent. Thus information of properties of these materials helps in accepting the importance of material science with respect to cost and safety.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Identify various engineering materials used in chemical industries and describe solid state of material science	R,U,
02	Select metals and alloys in industries	R,U,
03	Utilize concept of material forming and testing	R,U, A
04	Select different Insulating and Ceramic Materials in industries	R,U,A
05	Select different Miscellaneous materials in industries.	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			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	0	3	70	30	0	0	100

Course Content:

Unit No.	Content (Topics and Sub-topics)	No. of Hours	% of Weightage
1.	**Properties of Materials** 1.1 Scope of material science 1.2 General principles of selection of materials 1.3 Definition and explanation of 1.3.1 Melting point 1.3.2 Boiling point 1.3.3 Specific heat 1.3.4 Thermal conductivity 1.3.5 Thermal expansion 1.3.6 Thermal insulation 1.3.7 Stress 1.3.8 Strain 1.3.9 Yield stress 1.3.10 Fatigue 1.3.11 Creep 1.4 Factors affecting material properties	4	10
2.	**Solid state** 2.1 General characteristics of solid state 2.2 Amorphous and crystalline solids 2.3 Classification of crystalline solid 2.3.1 Molecular solids 2.3.2 Ionic solids 2.3.3 Metallic solids 2.3.4 Covalent or Network solids 2.4 Crystal lattices and Unit cells 2.5 Imperfections in solids 2.6 Electrical properties of solids	7	16
3.	**Metals** 3.1 Differentiate 3.1.1 Metals and non-metal 3.1.2 Ferrous and non-ferrous metal 3.2 Physical properties and application of metals: 3.2.1 Cast Iron 3.2.2 Copper 3.2.3 Aluminium	7	14

	3.2.4 Chromium 3.2.5 Nickel 3.2.6 Tin 3.2.7 Lead 3.2.8 Zinc 3.2.9 Tungsten 3.2.10 Silver 3.2.11 Stainless steel		
4.	**Alloys** 4.1 Classification of alloys 4.2 Differentiate ferrous and non-ferrous alloys 4.3 Composition , Properties and application of alloys: 4.3.1 Carbon steel 4.3.2 Duralumin, 4.3.3 Gun metal 4.3.4 Monel metal 4.3.5 Babbitt metal 4.3.6 Brass 4.3.7 Bronze	6	12
5.	**Material forming and Testing** 5.1 Introduction, Classification and theory of material forming process 5.1.2 Forging 5.1.2 Casting 5.1.3 Rolling 5.2 Importance of material testing 5.2.1 Introduction of destructive and Non-destructive testing 5.3 Introduction, principle, procedure and applications of: 5.3.1 Dye Penetration Testing 5.3.2 Hydrostatic Testing 5.3.3 Pneumatic Testing 5.3.4 Radiography Testing 5.3.5 Visual inspection: its importance and tools used for Visual Inspection	8	20
6	**Insulating and Ceramic Materials** 6.1 Classification of thermal insulators 6.2 Properties and applications of Thermal insulation 6.3 Factors affecting thermal conductivity of insulators 6.4 Composition, properties and uses of Ceramic materials 6.5 Classification, properties and uses of refractories	7	16

	6.6 Composition, properties and uses of: 6.6.1 Soda lime glass 6.6.2 Borosilicate glass 6.6.3 High silica glass 6.6.4 Fiber glass 6.6.5 Glass wool 6.7 Composition, properties and uses of porcelain		
7	**Miscellaneous Materials** 7.1 Definition, Classification, Properties and Uses of: 7.1.1 Plastic 7.1.2 Rubber 7.1.3 Fiber 7.2 Paints: Properties, classification, ingredients and uses 7.3 Varnishes: Properties, classification , ingredients and uses 7.4 Gaskets: classification and uses	6	12
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
26	**43**	**31**	**0**	**0**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Material science and processes	Hazara Chaudhary S.K.	Indian book distribution co.

2	Engineering Materials	RangwalaSC, RangwalaK.S.	Charotar publishing house pvt. limited
3	Engineering Materials	RajputR.K.	Chand and Co. New Delhi
4	Material Science & Metallurgy	Dr.RB Choudary	Khanna Publications

(b) Open source software and website:

1. www.nptel.iitm.ac.in
2. www.khanacademy
3. web.iitd.ac.in/~sunlight/MEL120/L2_Engineering_Materials.pdf
4. http://engineershandbook.com/Materials
5. www.engineeringtoolbox.com/engineering-materials-properties-d_1225.html
6. http://nptel.iitm.ac.in/courses.php

Suggested Project

Only one project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total work load on each students due to the micro-project should be about **16 (sixteen) student engagement *hours*** (i.e. about one hour per week) during the course. The students ought to submit micro-project by the end of the semester (so that they develop the industry oriented cOs).

A suggestive list of projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

- Build a Chart showing different materials
- Surf different websites related materials
- Collect relevant information about materials list
- Prepare chart on physical properties, types, characteristics, composition and application of material
- Prepare PowerPoint presentation on physical properties, types, characteristics, compositions and application of material

Suggested Activities for Students: If any

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare small reports (of 1 to 5 page for each activity). For micro project report should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare specification of some materials.

b) Give seminar on any relevant topic.

c) Undertake a market survey of different materials.

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