

Bachelor of Technology (B.Tech)

B. Tech. Semester V

Subject Name: Chemical Engineering Materials

Subject Code: BTCH13503

Type of course: Professional Core course

Prerequisite: Basics of atomic structure

Rationale: Selection of material of construction in equipment design, maintenance and corrective measures for various engineering materials, Awareness about the advancements in the area of materials used in chemical industries.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
2	0	0	2	60	25	15	00	00	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No	Topics	Teaching Hrs.	Module Weightage%
1.	Introduction to Engineering Materials Classification of engineering materials, Engineering requirements from materials, Basics of crystals and their correlated properties, Factors that govern material selection for engineering applications, Micro and macro examination	2	7
2.	Properties of Materials Mechanical, Electrical and magnetic properties of materials, Selection of material like SS, Ti/Zr alloy and design for corrosion control, Factors determining the choice of materials of construction in chemical industries.	2	7
3.	Metals: Their behaviours and properties Solidification of metals and alloy, Nucleation and Growth, Solidification defects, Effects of Structure on Mechanical Properties, Methods to control the grain structure resulting from solidification, Cooling curve of pure metal and alloy, Deformation in polycrystalline materials, Mechanical testing of materials (destructive & non-destructive) testing methods.	3	9
4.	Ferrous metals and its Alloys Iron and their alloys - Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical industries. Phase Diagrams and Phase Transformation, TTT and CCT Diagrams. Iron-Iron Carbide and Iron-carbon diagrams, Overview of different types of irons - Wrought iron, Pig iron, Cast iron, White Cast Iron, Grey Cast Iron, Malleable Cast Iron and their properties and characteristics, deformation of metals, Types of steel like Chromium, Molybdenum and	3	10

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	Manganese steels		
5.	Corrosion Engineering: Electrochemical principles, different types of corrosion, Polarisation, mechanisms of corrosion control and prevention, preventive coatings. Corrosion behaviour of important alloys such as stainless steels, brass etc.	4	13
6.	Inorganic, Organic & Other Materials: Glass, silicon, concrete & ceramic materials, high polymers, rubbers, wood, graphite, insulating & cementing materials, smart materials.	3	12
7	Structure and Imperfections in Crystals Introduction, Unit cells and their lattice structure, coordination number, crystal structure of metals, Atomic packing factor, Crystallographic planes and directions, Polymorphism and Allotropy, Diffusion in solids, Imperfection in crystals and their types.	3	12
8	Effect of structure on properties: Subatomic to macroscopic level. Modification and control of material properties	5	15
9	Applications of advance materials in chemical Engineering: Colloidal Materials and their Industrial applications, Surfactants, Mixed surfactants, Micelles, Vesicles, Reverse micelles, Emulsions, Macro-emulsions, foams, Thin Films, microbial polymers, green solvents, Industrial enzymes, Protein as Enzymes, Gels and Smart Hydrogels, Core and shell hydrogel, green hydrogel, stimuli responsiveness hydrogel, Nano materials and their applications in medicine, food and agriculture, cosmetics, waste water treatment.	5	15

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	25	30	05	05	05

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom'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.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Nature and Properties of Engineering Materials	Zaster Zebski D	John Wiely & Sons	1976	2 nd Edition
2	Chemical Engineering Materials	Chaudhry H	Indian Book Distributing Company, Delhi	1982	2 nd Edition
3	Elements of Material Science & Engineering Structures, Properties and Performance	Vlack V	Wesley Publishing Company	1989	2 nd Edition
4	Chemical Engineering Materials	Rumford F	Constable and Company Limited	1987	2 nd Edition

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5	Process Equipment Design	Dawande S.D	Denett & Company ISBN 8190322885 9788190322881	2015	7 th Edition
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SPECIMEN TASKS THAT CAN BE ASSIGNED: (CA2 component)

Sr No	Description
1	Study of suitable MOC selection options for various chemicals. (Different concentrations, phases)
2	Relevant accident case study report to be submitted as per format.

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks weightage%
CO-1	Understand and remember important chemical and mechanical properties and classification of engineering materials and metals.	20
CO-2	Analyze crystal structure, imperfections and effect on structures	20
CO-3	Evaluate different types of corrosion and describe preventive methods.	15
CO-4	Evaluate different microstructure, crystallography aspects and defects of Chemical Engineering materials and metals.	25
CO-5	Know about the advancements in the area of materials used in chemical industries and apply the knowledge for selection of the same	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO-1	3	1	1	2	2	3	3	1	1	3	3	3	2	2	1
CO-2	3	3	1	3	2	1	2	1	2	3	3	3	3	3	2
CO-3	1	2	1	3	2	2	2	1	2	3	3	3	3	3	2
CO-4	2	1	1	3	3	3	1	1	1	3	2	3	2	2	1
CO-5	3	1	2	3	3	2	3	3	2	2	2	3	3	2	1
Rationale*	12	8	6	14	12	11	11	7	8	14	13	15	13	12	7

Rationale*: All COs are satisfying the well-defined POs & PSOs

List of Open Source/learning website:

- <https://nptel.ac.in/courses/113/104/113104081/>, Defects in crystal structure
- <https://nptel.ac.in/courses/113/104/113104085/>, Crystal imperfections
- <https://nptel.ac.in/courses/104/106/104106093/>, Bravais Lattice, Crystallography
- <https://nptel.ac.in/courses/112/106/112106227/>, Crystallography and Diffraction