



**Subject Code: 01CH0402**

**Subject Name: Material Science and Composition**

**B.Tech. Year: II (Semester IV)**

**Objective:** Materials Science is at the core of nanotechnology, the production of machines and devices at molecular levels, which is likely to drive the next technological revolution.

**Credits Earned:** 4 Credits

**Course Outcomes:** After completion of this course, student will be able to:

1. To analyze the various properties of the engineering materials.
2. To relate the practical importance and relevance of metals and alloys in chemical industry.
3. To utilize the technological methods related to material strength and diffusion concepts.
4. To predict the usage of various materials.

**Pre-requisite of course:** Engineering Chemistry 1 & 2

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
3	0	2	4	50	20	30	25	25	150

**Contents:**

Unit	Topics	Contact Hours
1	<p><b>Structure of Crystalline Solids</b></p> <p><b>Types of Solids:</b> Amorphous &amp; Crystalline, Atomic bonding in solids,  <b>Crystal structure &amp; crystal system:</b> reciprocal lattice, Bravais Lattice, miller indices, closed packed structures, determination of crystal structures, coordination number,  <b>Crystal defects &amp; imperfections:</b> Point defects in crystals; Dislocations; Twins, Grain boundary, Stacking faults.</p>	6
2	<p><b>Properties of Engineering Materials</b></p> <p><b>Mechanical Properties:</b> Isotropy, Anisotropy, Plasticity, Elasticity, Toughness, Resilience, Tensile Strength, Malleability, Ductility, Brittleness, Hardness, Fatigue, Creep, Mechanism of creep, wear resistance.  <b>Electrical Properties:</b> Resistivity, Conductivity (ionic &amp; electrical), Semiconductors, Superconductivity, Insulators, Ferroelectricity, Energy Bands in solids, classification of materials based on band gap.  <b>Magnetic Properties:</b> Magnetic moment, its origin, ferro and ferri-magnetism, dia- and para-magnetism, ferrites, use of magnetic materials.</p>	6



3	<b>Metals and Alloys</b>  Types of metals and alloys, fabrication of metals, thermal processing of metals-heat treatment of steels, Microbial corrosion, Microstructure, properties and applications of ferrous and non-ferrous alloys,	7
4	<b>Diffusion mechanisms</b>  Fick's laws and application of diffusion in sintering, doping of semiconductors and surface hardening of metals, steady state diffusion, non-steady state diffusion, factors influencing diffusion  <b>Rubber, Lubricants and adhesives</b> Definition, Characteristics, Types	10
5	<b>Ceramics, Composites and nano-materials</b>  <b>Ceramics:</b> White pottery- definition, manufacture and uses, Glasses and Crystalline ceramics <b>Composite Materials:</b> Metal matrix, Ceramic matrix and polymer matrix, advantages and applications. <b>Nanomaterials:</b> Introduction, properties (size dependent). Synthesis-bottom up approach (sol-gel, precipitation, gas condensation & chemical vapour condensation processes). Nano scale materials- carbon nano tubes, nano wires, fullerenes, dendrimers, nano rods, & nano composites.	10
<b>Total Hours</b>		<b>39</b>

**List of Experiments:**

- 1 To prepare the specimen for microscopic observation.
- 2 To determine the strength and hardness of ferrous specimen.
- 3 To study the effect of Heat treatment process on the Hardness and Tensile Strength of Mild Steel.
- 4 To show the effect of different quenching media (Oil, Water and Brine) on the hardness of Mild steel.
- 5 To determine the surface defect by liquid penetrant test.
- 6 To determine the surface defect by magnetic particle test.
- 7 To determine the internal defect by Ultrasonic Test.
- 8 To study the process involved in White pottery practically.
- 9 To study about the various methods of manufacture of glass.

**References:**

1. "Callister's Material Science and Engineering", 2/e R. Balasubramaniam, Wiley India.



2. "Elements of Material Science and Engineering", 6/e, Lawrence H. Van Vlack, Pearson Education.
3. "The Science and Engineering of Materials", 6/e, Donald R. Askeland and Pradeep P. Phule, Cengage Learning.
4. "Principles of Materials Science and Engineering", W F Smith, McGraw Hill.

**Suggested Theory distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	35%	25%	20%	-	-

**Instructional Method:**

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory