K. S. INSTITUTE OF TECHNOLOGY

#14, Raghuvanahalli, Kanakapura Main Road, Bengaluru-5600109

DEPARTMENT OF MECHANICAL ENGINEERING

MATERIAL SCIENCE ENGINEERING CO-PO-PSO mapping

Course : MATERIAL SCIENCE ENGINEERING			
Course Incharge : Dr.NIRMALA L			
Type: CORE		Course Code:BME303	
No of Hours per week			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
3	2	5	52
Marks			
CIE Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objective of the Course:

This course enables students to:

- Explain the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids.
- Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
- Identify the heat treatment, cooling method for controlling the microstructure and plastic deformation to modify their properties.
- Explain the powder metallurgy process, types and surface modifications.
- Apply the method of materials selection, material data, properties and knowledge sources for computer-aided selection of materials.

Course Learning Outcomes:

After completing the course, the students will be able to,

CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.	Apply(K3)
CO2	Understand the importance of phase diagrams and the phase transformations.	Apply(K3)
CO3	Apply full, surface heat treatment and strengthening mechanisms for controlling the microstructure of materials.	Apply(K3)
CO4	Correlate between material properties with component design and identify various kinds of defects.	Apply(K3)

CO5	. Apply the method of materials selection, material data and knowledge sources for selection of materials.	Apply(K3)

Syllabus Content:

Module 1 Structure of Materials Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding: Ionic Bonding and Metallic bonding. Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, Coordination number, atomic Packing Factor of all the Cubic structures and Hexa Close Packed structure. Classification and Coordination of voids, Bragg's Law. Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids. Slip, Twinning. LO: At the end of this session the student will be able to, 1. Understand the concept of crystal structure, 2. Explain Imperfections in Solids	CO1 10hrs PO1-3, PO9-2 PO10-2
Module 2 Physical Metallurgy Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules Diffusion: Diffusion Mechanisms: Vacancy Diffusion and Interstitial Diffusion, Fick's laws of diffusion, Factors affecting diffusion. Phase Diagrams: Gibbs Phase Rule, Solubility limit, phase equilibrium and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions: Eutectic reaction, Eutectoid reaction and Peritectic reaction, Lever Rule, Iron-Carbon Diagram. Effect of common alloying elements in steel. Numerical on Lever rule. LO: At the end of this session the student will be able to, 1. Identify Hume- Rothery Rules Diffusion: Diffusion Mechanisms: 2. Explain solid solution and its types. 3. Understand phase diagrams. Identifying percentage of composition in various phases at specific temperature using lever rule.	CO2 10 hrs PO1-3 PO2-2, PO9-2, PO10-2
Module 3 Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation. Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, Recovery-Recrystallization-Grain Growth. Strengthening mechanisms: Strain hardening, Precipitation hardening (Solid-Solution Strengthening), Grain refinement. LO: At the end of this session the student will be able to, 1. Understanding TTT and CCT curves. 2. Explain the importance of various heat treatment processes which influences the properties of a material.	CO3 10 hrs PO1-3, PO9-2, PO10-2

Identify ferrous materials, their properties and applications	
Module 4 Surface coating technologies: Introduction, coating materials, coating technologies, types of coating: Electro-plating, Chemical Vapor Deposition(CVD), Physical Vapor Deposition(PVD), High Velocity Oxy-Fuel Coating, advantages and disadvantages of surface coating. Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical methods: Chopping or Cutting, Abrasion methods, Machining methods, Ball Milling and Chemical method: Chemical reduction method. Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy. LO: At the end of this session the student will be able to, 1. Explain the role of Surface coating technologies for todays catering. 2. Identify and understand the Powder Production Techniques	CO4 10 hrs PO1-3 PO9-2 PO10-2 PSO1-1 PSO2-1
Module 5 Engineering Materials and Their Properties: Classification, Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel. Non-Ferrous materials: Properties, Compositions and uses of Copper, Brass, Bronze. Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix. Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, Applications of composite materials. Mechanical and functional properties of Engineering Materials The Design Process and Materials Data: Types of design, design tools and materials data, processes of obtaining materials data, materials databases. Material Selection Charts: Selection criteria for materials, material property Charts, deriving property limits and material indices. LO: At the end of this session the student will be able to, 1.Engineering Materials and Their Properties 1. Understand the importance of composite material. 2. Design Process and Materials Data .	CO5 10 hrs PO1-3 PO9-2 PO10-2 PSO1-1 PSO2-1
1.	

Reference Books:

Reference Books 1. Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials

1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.

2. Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials ,An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.

3. Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4th Edition, Cengate

Learning.

4. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi,2008

Useful Websites

Web links and Video Lectures (e-Resources): Web links and Video Lectures (e-Resources):

- 1. Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
- 2. Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials.

Useful Journals

- Journal of Material Science
- Journal of Wear
- Journal of composite materials

Teaching and Learning Methods:

1. Lecture class: 35 hrs.
2. Field visits/Group Discussions/Seminars: 5
3. Practical classes: 10

Assessment:

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

CIE marks for the theory component are 25 marks and that for the practical component is 25 marks

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Society **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Mngmt & Finance **PO12:**Life long Learning
PSO1: Ability to apply concept of mechanical engineering to design a system, a component or a process/system to address a real world challenges	**PSO2:** Ability to develop effective communication, team work, entrepreneurial and computational skills.

CO-PO-PSO MAPPING

BME303	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	K3	3	2	-	-	-	-	-	-	2	2				2
CO2	K3	3	3	-	-	-	-	-	-	2	2				2
CO3	K3	3	1	-	-	-	-	-	-	2	2				2
CO4	K3	3	1	-	-	-	-	-	-	2	2			1	2
CO5	K3	3	2	-	-	-	-	-	-	2	2			1	2
BME303 Before CBS		3	1.8							2	2			1	2
case studies			2							2	2			1	2
AFTER CBS		3	2							2	2			1	2

CO-PO MAPPING Justification Table				
Sl. No.	CO	PO	Number Of Key Elements of PO Mapped To CO	Justification
• **CO1:** Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.				
1.	CO1	1	The students will able to gain • Knowledge of Mathematics • Knowledge in Specific Engineering Problem • To Find Solution	3 Keywords Are Mapped Hence Strength Is 3
2		2	The students will able to • Identify • Analyze Complex	2
3		9	The students will able to work effectively in teams to conduct LAB experiment as an • Individual • In a Team	2
4		10	The students will able to Communicate effectively by • Write record Reports • Analyse the experimental results	2
5		PSO2	The students will able to work effectively in teams to conduct LAB experiment as an • Ability to develop effective communication • Ability to develop effective team work	1
• **CO2:** Understand the importance of phase diagrams and the phase transformations.				

6	CO2	1	**The students will able to gain the** • Knowledge of Mathematics • Knowledge of Science, • Knowledge in Specific Engg. Problem & To Find Solution	3
7		2	The students will able to • Identify • Formulate of phase diagrams and the phase transformations • Complex problems are analyzed	3
8		9	The students will able to work effectively in teams to conduct LAB experiment as an • Individual • In a Team	2
9		10	The students will able to Communicate effectively by • Write record Reports • Analyse the experimental results	2
10		PSO2	The students will able to work effectively in teams to conduct LAB experiment as an • Ability to develop effective communication • Ability to develop effective team work	1
CO3: Apply full, surface heat treatment and strengthening mechanisms for controlling the microstructure of materials				
11	CO3	1	The students will able to gain the • Knowledge of Mathematics • Knowledge of Science, • Knowledge in Specific Engg. Problem & To Find Solution	3
12		2	The students will able to • Identify surface heat treatment and strengthening mechanisms	1
13		9	The students will able to work effectively in teams to conduct LAB experiment as an • Individual • In a Team	2
14		10	The students will able to Communicate effectively by • Write record Reports • Analyse the experimental results	2
15		PSO2	The students will able to work effectively in teams to conduct LAB experiment as an • Ability to develop effective communication • Ability to develop effective team work	1
CO4: Apply full, surface heat treatment and strengthening mechanisms for controlling the microstructure of materials.				
16	CO4	1	The students will able to gain the • Knowledge of Mathematics • Knowledge of Science, • Knowledge in Specific Engg. Problem & To Find Solution	3
17		2	**The students will able to** • Identify strengthening mechanisms and select for a material	1

18		9	The students will able to work effectively in teams to conduct LAB experiment as an • Individual • In a Team	2
19		10	The students will able to communicate effectively by • Write record Reports • Analyse the experimental results	2
20		PSO1	The students will able to gain the ability to • Ability to apply concept of mechanical engineering to select a material in design process to address a real world challenges	1
21		PSO2	The students will able to work effectively in teams to conduct LAB experiment as an • Ability to develop effective communication • Ability to develop effective team work	2
CO5: To Find Solution Correlate between material properties with component design and identify various kinds of defects				
22	**CO5**	1	The students will able to gain • Knowledge of Mathematics • Knowledge in Specific Engg. Problem &.	3
23		2	The students will able to • Identify • Formulate material charts	2
24		9	The students will able to work effectively in teams to conduct LAB experiment as an • Individual • In a Team	2
25		10	The students will able to Communicate effectively by • Write record Reports • Analyse the experimental results	2
26		PSO1	The students will able to gain the ability to • Ability to apply concept of mechanical engineering to select a material in design process to address a real world challenges	1
27		PSO2	The students will able to work effectively in teams to conduct LAB experiment as an • Ability to develop effective communication • Ability to develop effective team work	2

Signature of Course in-Charge **Signature of Module Coordinator** **Signature of HOD**

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