SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES – CHITTOOR – 517 127

(Autonomous – NAAC Accredited)

DEPARTMENT of MECHANICAL ENGINEERING

MATERIAL SCIENCE AND METTALLURGY (23A03303)

Class: II year III Semester **Branch:** Mechanical Engg.

QUESTION BANK

Prepared by

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INSTITUTE VISION

To emerge as a Centre of Excellence for Learning and Research in the domains of engineering, computing and management.

INSTITUTE MISSION

- Provide congenial academic ambience with state -of -art of resources for learning and research.
- Ignite the students to acquire self-reliance in the latest technologies.
- Unleash and encourage the innate potential and creativity of students.
- Inculcate confidence to face and experience new challenges.
- Foster enterprising spirit among students.
- Work collaboratively with technical Institutes / Universities / Industries of National and International repute

DEPARTMENT VISION

To become a Centre of excellence in Mechanical Engineering studies and research.

DEPARTMENT MISSION

- Provide congenial academic ambience with necessary infrastructure and learning resources
- Inculcate confidence to face and experience new challenges from industry and society.
- Ignite the students to acquire self reliance in the latest Technologies
- Foster Enterprising spirit among students

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

Graduates of Mechanical Engineering shall

PEO1: Have Professional competency through the application of knowledge gained from subjects like Mathematics, Physics, Chemistry, Inter-Disciplinary and core subjects like Manufacturing Engineering, Thermal Sciences, CAD/CAM and Design & Development. **(Professional Competency)**.

PEO2: Excel in one's career by critical thinking towards successful services and growth of the organization or as an entrepreneur or through higher studies. **(Successful Career Goals).**

PEO3: Enhance knowledge by updating advanced technological concepts for facing the rapidly changing world and contribute to society through innovation and creativity. **(Continuing Education and Contribution to Society).**

PROGRAM SPECIFIC OUTCOMES (PSO'S)

Students shall

PSO1: Apply the knowledge obtained in core areas for the design, analysis and manufacturing of mechanical systems and processes.

PSO2: Exhibit novel concepts on product development with the help of modern CAD/CAM integration, while ensuring best manufacturing practices.

II B.Tech III Semester	L	T	P	C
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23A03303 MATERIAL SCIENCE AND METALLURGY

COURSE EDUCATIONAL OBJECTIVES:

1. Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.
2. Study the behavior of ferrous and non ferrous metals and alloys and their application in different domains.
3. Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
4. Grasp the methods of making of metal powders and applications of powder Metallurgy.
5. Comprehend the properties and applications of ceramic, composites and other advanced methods.

UNIT –1: Structure of Metals and Constitution of alloys: (9)

Crystallization of metals, Packing Factor -SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries–determination of grain size. Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions. Hume Rothery's rules, intermediate alloy phases, and electron compounds

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3C.

UNIT –2: Ferrous metals and alloys & Non-ferrous Metals and Alloys (9)

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey castiron, Spheriodal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT –3: Heat treatment of Steels(9)

Heat treatment of Steels: Effect of alloying elements on Fe-Fe3C system, annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface – hardening methods, age hardening treatment, Cryogenic treatment.

UNIT –4: Powder Metallurgy (9)

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization- Granulation- Reduction- Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

UNIT –5: Ceramic and Advanced materials (9)

Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials and smart materials.

On successful completion of the course, students will be able to:

	Course Outcomes	POs related to COs
CO1	Apply the knowledge of mathematics, science, and engineering fundamentals of alloys and Phase diagram of various materials and the classification of micro structure in steel and cast iron.	P01,P02,P03,P04
CO2	Acquire the knowledge of engineering fundamentals for heat treatment process. Identify, formulate, analysis and apply appropriate techniques used in all the heat treatment process with an understanding of its limitations.	P01,P02,P03,P04
CO3	Understand the engineering knowledge of ferrous and non-ferrous metal and its alloys. Identify, formulate the appropriate techniques and engineering application of ferrous and non-ferrous metal and alloys.	P01,P02,P03,P04
CO4	Understand the engineering knowledge of polymers, ceramics and composites. Identify, formulate the appropriate techniques and engineering application of polymers, ceramics and composites.	P01,P02,P03,P04
CO5	Understand the engineering knowledge of mechanical properties and its deformation mechanisms.	P01,P02,P03,P04

Text Books:

1. Material Science and Engineering, R.K.Rajput, 4/e, 2013, S.K. Kataria and Sons Publications.
2. Material Science & Metallurgy, O.P.Khanna, 2014, Dhanpat Rai Publications.

Reference Books:

1. Introduction to Physical Metallurgy, Sidney H Avner, 2/e, 2013, Tata McGraw-Hill Education Pvt. Ltd., Noida.
2. Materials Science and Engineering-An Introduction, William D. Callister, 6/e, 2010, Wiley India Pvt. Ltd.
3. Introduction to Engineering Materials, B.K.Agrawal, 1/e, 2003, Tata McGraw-Hill Education Pvt. Ltd., Noida.
4. Material Science and Engineering, V. Raghavan, 5/e, 2009, Prentice-Hall of India, Pvt. Ltd.
5. Elements of Material Science and Engineering, Lawrence H.Vanvlack, 6/e, 2002, Pearson Education, New Delhi.
6. Material Science and Metallurgy for Engineers, Dr.V.D. Kodgire and S.V.Kodgire, 25/e, 2009, Everest Publishing House, Pune.

QUESTION BANK

Question No.	Questions	Bloom's Level
UNIT – 1: Structure of Metals and Constitution of alloys:		
1	Define solid solution.	**BT1**
2	What is meant by edge dislocation?	**BT2**
4	Define solidification.	**BT1**
6	Identify the reactions in iron –iron carbide equilibrium diagram.	**BT2**
7	What is lever rule?	**BT4**
8	What is the usefulness of phase diagrams?	**BT3**
9	Explain solidification of a pure metal.	**BT4**
10	Draw the cooling curve of a pure metal and solid solution.	**BT2**
11	Demonstrate different types of solid solutions.	**BT5**
12	Write the equations of eutectic, peritectic, eutectoid and peritectoid reactions.	**BT4**
13	Explain Fe-Fe_3C phase diagram.	**BT1**
14	Identify and analyse the different types of crystal defects.	**BT4**
16	Write the Gibb`s phase rule.	**BT1**
17	Write the reactions that occur in phase diagrams.	**BT3**
18	Explain Hume-Rothery rules for the formation of substitutional solid solutions.	**BT2**
19	Explain isomorphous system with neat sketch	**BT2**
20	Analyze Cu-Ni and Al-Cu phase diagram.	**BT4**

Question No.	Questions	Bloom's Level
UNIT – 2: FERROUS AND NON FERROUS METALS		
1	What do you mean by ferrous alloys?	**BT2**
2	Why lathe beds are made by gray cast iron?	**BT5**
3	What are the advantages of non-ferrous alloys over ferrous alloys?	**BT4**
4	Write notable properties of Aluminum.	**BT5**
5	List out various properties of copper.	**BT1**
6	What properties of non-ferrous alloys made them to use at different applications?	**BT2**
7	What is the effect of sulphur and silicon alloying elements on iron?	**BT2**
8	Classify the steels by the percentage of carbon. Explain their properties.	**BT2**
9	How do you specify the steels? Explain.	**BT3**
10	Explain different types of cast irons by highlighting their properties, uses and microstructures.	**BT3**
11	Analyze various aluminum alloys with their composition, properties and applications.	**BT4**
12	Mention the applications of high carbon steels.	**BT2**
13	Illustrate the properties of titanium and their alloys.	**BT5**

Question No.	Questions	Bloom's Level
	UNIT – 3: HEAT TREATMENT STEELS	
1	Define hardness.	**BT1**
2	What is the information that can be obtained from TTT diagram?	**BT2**
3	List out the phases in TTT diagram.	**BT1**
4	How do you change the structure of material?	**BT2**
5	Identify the purpose of tempering?	**BT3**
6	Define critical cooling rate.	**BT1**
7	Identify the phase in TTT diagram that has highest hardness value?	**BT2**
8	What do you mean by austempering?	**BT5**
9	What is annealing? Explain different types of annealing.	**BT1**
10	List different types of heat treatments.	**BT4**
11	Analyse various heat treatment processes?	**BT4**
12	What are the objectives of heat treatment?	**BT2**
13	How do you construct TTT diagrams? Draw the same	**BT5**
14	Explain flame and induction hardening methods.	**BT6**
15	Explain case hardening techniques.	**BT4**
Question No.	Questions	**Bloom's Level**
	UNIT – 4: POWDER METALLURGY	
1	Explain the basic steps involved in the powder metallurgy process with a neat flow diagram.	**BT1**
2	Describe the atomization method of producing metal powders with its advantages and applications.	**BT2**
3	What is milling in powder metallurgy? Explain its working principle and uses.	**BT2**
4	Explain the reduction and electrolytic deposition methods for producing metal powders.	**BT1**
5	Describe different compacting methods used in powder metallurgy and their significance.	**BT2**
6	What is sintering? Explain the mechanism and stages of sintering in detail.	**BT3**
7	Explain the various methods of manufacturing sintered parts.	**BT2**
8	What are secondary operations in powder metallurgy? Explain infiltration and impregnation processes.	**BT4**
9	List and explain the important applications of powder metallurgical products.	**BT1**
10	Discuss the advantages and limitations of powder metallurgy over conventional manufacturing processes.	**BT2**

Question No.	Questions	Bloom's Level
	UNIT – 5: CERAMICS AND ADCVANCED MATERIALS	
1	Define composites.	**BT1**
2	Define ceramics.	**BT1**
3	What is hybrid composite?	**BT2**
4	Identify the natural composite materials.	**BT3**

5	Explain the classification of composite materials.	**BT2**
6	Demonstrate the applications of composite materials.	**BT3**
7	Illustrate the different fiber reinforced composite materials.	**BT2**
8	Classify the polymers based on structure.	**BT3**
9	Discuss about cermets.	**BT1**
10	Demonstrate the properties and applications of metal matrix composites.	**BT5**
11	Enumerate the differences between thermoplastics and thermosetting plastics.	**BT2**
12	Identify the properties that can be improved by composites?	**BT2**
13	Discuss various applications of polymers.	**BT2**
14	What do you mean by nano composite materials?	**BT3**
15	Why composites are important?	**BT2**
16	Classify of ceramics, and what are the applications.	**BT2**

Note:

Bloom's Taxonomy

Bloom's Level	Descriptions	Bloom's Level	Descriptions
BT 1	**Remember**	**BT 2**	**Understand**
BT 3	**Apply**	**BT 4**	**Analyze**
BT 5	**Evaluate**	**BT 6**	**Create**

*****ALL THE BEST*****