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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; March - 2021

Material Science and Metallurgy

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Ability to identify different types of crystalline structure, defects of metals and laws governing the diffusion phenomena.

CO2: Ability to apply the knowledge of mechanical behavior to select appropriate material for given automotive component.

CO3: Ability to Interpret the phase diagrams of metals and alloys and use them in thermal processing of the materials.

CO4: Ability to Select appropriate heat treatment process for specific requirements.

CO5: Describe the effect of alloying elements on properties and fabrication process and applications of composite materials with economic and social concerns.

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for Maximum of* ***18 marks*** *from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	State Fick's First and Second law of diffusion.	2	L1,2	CO1	PO2
b.	List different parameters affecting fracture.	2	L1,2	CO2	PO1
c.	Define the term "PHASE".	2	L1	CO3	PO1
d.	What do you mean by heat treatment? Why it is necessary?	2	L1	CO4	PO2
e.	Classify the composite material based on the type of matrix.	2	L2	CO5	PO2
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	What are vacancies? How they are formed and explain the formation of Schottky and Frenkel defects.	9	L1,2	CO1	PO2
b.	i) Define engineering stress and strain, also true stress and strain. ii) A 12.5 mm dia aluminum alloy test bar is subjected to a load of 2 tones. If the dia of the bar is 12.4 mm at this load, calculate engineering stress, engineering strain, true stress, and true strain. Assume no change in volume.	9	L3	CO1	PO3
c.	Draw the stress, strain diagram (Schematic) of mild steel and describe how the following properties can be obtained from the curve: i) Elastic modulus ii) Yield strength iii) UTS iv) Ductility	9	L3	CO1	PO3
	UNIT - II	**18**			
2 a.	State Griffith theory of fracture. Derive an expression for the stress required to propagate a crack in brittle material.	9	L3	CO2	PO3

Contd... 2

b.	How fractures are classified? State and explain different types of fracture giving appearance of the fracture in each case.	9	L3	CO2	PO1
c.	What is meant by creep? With the help of creep curve, explain different stages of creep.	9	L3	CO2	PO1

UNIT - III **18**

3 a.	Two metals *A* and *B* have their melting points at 900°C and 800°C respectively. The alloy pair forms a eutectic at 600°C of composition 60%*B* and 40%*A*. *A* and *B* have unlimited mutual liquid solubilities. Their solid solutions are as follows: 10%*B* in *A* at 600°C and 5%*B* in *A* at 0°C 8%*A* in *B* at 600°C and 4%*A* in *B* at 0°C Assume the liquidus, solidus and solvus lines to be straight. No solid state reactions or any intermediate phase changes occur in the series. i) Draw the phase diagram for the series and label all salient temperatures, compositions and regions. ii) Find the room temperature structure of an alloy of composition 60% *A* and 40%*B*, with respect to the number, type, extent and composition of the phases.	12	L4	CO3	PO4
b.	Discuss the solidification mechanism in pure metals. How do you distinguish homogeneous and heterogeneous nucleation?	6	L3	CO3	PO2
c.	Explain the steps involved in the construction of T-T-T diagram.	6	L2	CO3	PO1

UNIT - IV **18**

4 a.	Distinguish between Normalizing and Annealing. Describe the types of Annealing.	9	L3	CO4	PO2
b.	What is the purpose of surface hardening treatment? What types of steel can be surface hardened and how?	9	L2	CO4	PO2
c.	Explain induction hardening and flame hardening processes with the help of neat sketches.	9	L2	CO4	PO1

UNIT - V **18**

5 a.	State the properties and uses of Grey, White, Malleable, and Spheroidal cast iron.	9	L2	CO5	PO2
b.	What is a composite material? How is it classified based on the shape of reinforcement and type of matrix. Explain any two from each classification.	9	L2	CO5	PO2
c.	Discuss the applications of composites.	9	L2	CO5	PO1

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