

Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Programme Name : B. Tech- Mechatronics

Semester : III

Course Name : Materials Science

Time : 03 hrs.

Course Code : MEMA2001

Max. Marks : 100

Nos. of page(s) : 2

Instructions: Attempt all questions. One question from section B and C have an internal Choice. Assume any missing data if required.

SECTION A

S. No.		Marks	CO
Q1	Neatly sketch the stress strain curve for ductile and brittle materials.	4	CO1
Q2	State Hume Rothery's rules and discuss in detail	4	CO1
Q3	Define stress concentration and its negative effect on fatigue life.	4	CO2
Q4	Differentiate in between eutectic, eutectoid and peritectic invariant reactions.	4	CO3
Q5	Explain why materials are stronger in wire form than bulk form.	4	CO4

SECTION B

Q6	(a) Define homogeneous and heterogeneous nucleation.	3	CO1
	(b) Write the coordination number for BCC, FCC, and HCP unit cell.	3	
	(c) Define heat treatment process and mentioned its purposes.	4	
Q7	(a) Differentiate ductile fracture and brittle fracture.	5	CO2
	(b) Explain transgranular and intergranular fracture with a neat sketch.	5	
Q8	(a) Construct a eutectoid phase diagram for the system A-B for the following data and label the phase diagram: Melting point of A = 1000 °C Melting point of B = 800 °C Eutectoid Point = 600 °C at 40 atomic % B Maximum solubility of A in B at 500 °C= 15 atomic % Maximum solubility of B in A at 500 °C= 22 atomic % Limits of solid solution at 300 °C = 10 atomic % in A, 5 atomic % in B.	8	CO3
	(b) Write the invariant reaction with phase composition	2	
Q9	A		CO2
	(i) Define fatigue failure. Neatly sketch the various fatigue loading cycles.	5	
	(ii) Define Low cycle fatigue and explain the method to estimate the fatigue damage in metals.	5	
Or			

	<p>B</p> <p>(i) Explain Griffith theory of brittle fracture.</p> <p>(ii) Explain with neat sketches the two modes of fracture failure of metal.</p>	<p>5</p> <p>5</p>	
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SECTION-C

Q10	<p>(a) Classify heat treatment process</p> <p>(b) Describe full annealing, Recrystallization Annealing, Stress Relief Annealing, and Spheroidization Annealing.</p> <p>(c) Discuss cyaniding and nitriding processes.</p>	<p>6</p> <p>8</p> <p>6</p>	CO3
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Q11	<p>A. Analyze the Cu-Ag Phase diagram and answer the following questions:</p> <p>(i) Write the solubility limit and temperature of eutectic composition.</p> <p>(ii) Write the invariant reaction with phase composition.</p> <p>(iii) Sketch and explain the microstructure evolution of 50% Cu - 50% Ag alloy.</p> <div style="text-align: center;"> <p style="text-align: center;">Composition (at% Ag)</p> <p style="text-align: center;">Temperature (°C)</p> <p style="text-align: center;">Temperature (°F)</p> <p style="text-align: center;">Composition (wt% Ag)</p> </div> <p>iv. Develop the microstructure evaluation of Cu - Ag alloy at eutectic composition with its phase composition and relative amount of phase present.</p> <p style="text-align: center;">Or</p> <p>B.</p> <p>(a) List out different failure theories used during design of machine components.</p> <p>(b) Discuss any two theories of failure</p> <p>(c) Discuss how you will design a sword having hard surface and toughen core.</p>	<p>2</p> <p>2</p> <p>10</p> <p style="text-align: center;">CO4</p> <p>6</p> <p>5</p> <p>10</p> <p>5</p>	
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