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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Program: B.Tech APE Upstream **Semester – VI**
Subject (Course): Engineering Materials **Max. Marks : 100**
Course Code : GSEG 393 **Duration : 3 Hrs**
No. of page/s:

SECTION-A

Attempt all parts **(5X4=20)**

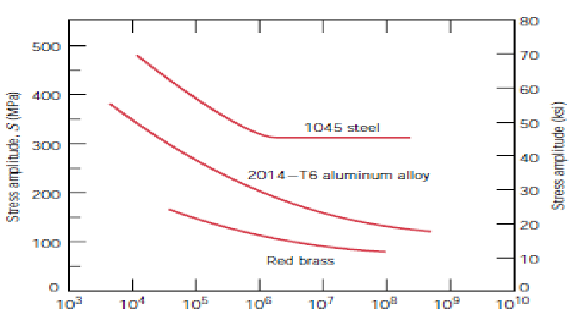
1) Define linear density. Compute linear density expression for FCC [100] and [111] directions in terms of atomic radius R. **CO-1**
2) Differentiate between ductile and brittle. Draw and enlist their microscopic and macroscopic fracture surface morphologies. **CO-2**
3) Define phase. A hypothetical A-B alloy of composition 40% B-60% A, at some temperature is found to consist of mass fraction of 0.66% α (alfa) and 0.34% β (beta). If the composition of the α (alfa) phase is 13% B-87% A, find the composition of β (beta). **CO-3**
4) Define recrystallization and recrystallization temperature. Draw the graph showing effect of full annealing on strength, ductility and grain structure at given temperature with respect to time. **CO-3**
5) Give the chemical composition of AISI 2760 steel. **CO-4**

SECTION-B

Attempt all parts **(4X10=40)**

6) Calculate the energy for vacancy formation in the silver, given that equilibrium number of vacancy at 800°C is 3.6 X 10^{23} /m^3. The atomic weight and the density (at 800°C) for silver are 107.9 gm/mol and 9.5 g/$cm^{3.}$ Value of K (Boltzman constant) = 8.62X 10^{-5} eV/ atom-K. **(CO-1)**

7) Define endurance limit and fatigue life. A12.5mm diameter cylindrical rod fabricated from a 2014-T6 alloy (Figure 9.46) is subjected to a repeated tension-compression load cycling along its axis. Compute the maximum and minimum loads that will be applied to yield a fatigue life of 1.0* 10^7cycles. Assume that the stress plotted on the vertical axis is stress amplitude, and data were taken for a mean stress of 50 Mpa. (use the plot given below) **(CO-2)**



8) Draw Fe-Fe_3C diagram. Explain all single phase regions, invariant points and reactions on invariant points in Fe- Fe_3C diagram. (use graph paper for the diagram) **(CO-3)**

9) Draw stress- strain diagram for mild steel. Explain all the important point present on the same diagram. A cylindrical rod 500 mm long, having a diameter of 12.7 mm, is to be subjected to a tensile load. If the rod is to experience neither plastic deformation nor an elongation of more than 1.3 mm when the applied load is 29,000 N , which of the four metals or alloys listed below are possible candidates? Justify your choice(s). **(CO-4)**

Material	*Modulus of Elasticity (GPa)*	*Yield Strength (MPa)*	*Tensile Strength (MPa)*
Aluminum alloy	70	255	420
Brass alloy	100	345	420
Copper	110	210	275
Steel alloy	207	450	550

OR

Derive the expression for true stress and true strain in terms of engineering stress and engineering strain. The following true stresses produce the corresponding true plastic strains for a brass alloy: What true stress is necessary to produce a true plastic strain of 0.21?

True Stress (psi)	*True Strain*
60,000	0.15
70,000	0.25

SECTION-C

Attempt all parts

10) Differentiate between hot working and cold working. What is the effect of hot working and cold working on the mechanical and metallurgical properties of materials? Explain various strengthening mechanisms. **(CO-4)**

11) Lead melts at 620°F and tin melts at 450°F. They form a eutectic containing 62 percent tin at 360°F. The maximum solid solubility of tin in lead at this temperature is 19 percent (α phase); of lead in tin, 3 percent (β phase) . Assume the solubility of each at room temperature is 1 percent.

(CO-3)

a) Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines, and areas.
b) Describe the solidification of a 40 percent tin alloy. Sketch its microstructure at room temperature, giving the chemical composition and relative amounts of the phases present
c) Draw the cooling curve for the above alloy. (Showing phases and degree of freedom at different temperature.

d) Find out the composition of alloy that will yield pro-eutectic β and total β weight fraction of 0.23 and 0.65 respectively just below eutectic temperature.

OR

A binary alloy having 28 wt % Cu & balance Ag solidifies at 779^0C. The solid consists of two pahses α & β. Phase α has 9% Cu whereas phase β has 8% Ag at 779^0C. At room temperature these are pure Ag & Cu respectively. Melting points of Cu & Ag are 1083^0 & 960^0C respectively.

a) Construct the phase diagram for this system on a piece of a graph paper and label each region.
b) Describe the solidification of a 22 percent Cu alloy. Sketch its microstructure at room temperature, giving the chemical composition and relative amounts of the phases present.
c) Draw the cooling curve for above alloy.
d) Find out the composition of alloy that will yield pro-eutectic α and total α weight fraction of 0.84 and 0.96 respectively just below eutectic temperature.