Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

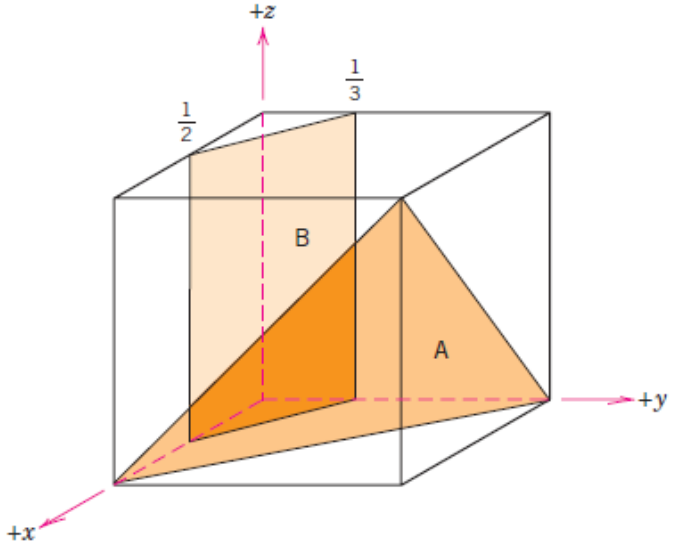
End Semester Examination, May 2019

Programme Name: B.Tech ADE **Semester** : IV
Course Name : Material Science **Time** : 03 hrs
Course Code : MEMA 2001 **Max. Marks** : 100
Nos. of page(s) : 3 pages
Instructions: Use graph sheet for drawing phase diagram in Q-11

SECTION A

S. No.		Marks	CO
Q 1	Define linear and planer density. Find the planer density of (111) plane in BCC crystal structure.	4	CO1
Q-2	Classify aluminum alloys. Write down the chemical composition and applications of duralumin.	4	CO-3
Q-3	Describe the significance of Ni and Cr in stainless steel.	4	CO-3
Q-4	Explain Austempring and Martempring with the help of TTT diagram.	4	CO-4
Q-5	Differentiate between ductile and brittle fracture.	4	CO-5

SECTION B

Q-6	a) Find the miller indices of the plane A and B shown in the cubic structure. **[4]**  b) Define burger vector. Differentiate between edge, screw and mixed dislocation. **[6]**	10	CO1

Q-7	Draw the labeled iron Fe-Fe_3C phase diagram (draw it on your answer sheet do not use graph sheet). 1kg of the steel having 0.4% carbon is cooled slowly from 1000 ^{0}C to just below the 723^{0}C temperature. Find the amount of pro-eutectoid ferrite and perlite at this temperature in grams.	**10**	**CO-2**
Q-8	Describe the following a) Magnesium alloys b) Brass and bronze	**10**	**CO-3**
Q-9	Define creep. Draw the typical creep curve and explain primary, secondary and tertiary creep in detail. **OR** Steady-state creep rate data are given here for some alloy taken at 473 K. $\dot{\epsilon}_s\ (h^{-1})$ | $\sigma[MPa\ (psi)]$ 2.5×10^{-3} | 55 (8000) 2.4×10^{-2} | 69 (10,000) If it is known that the activation energy for creep is 140,000 J/mol, compute the steady-state creep rate at a temperature of 523 K and a stress level of 48 MPa. Take the value of universal gas constant R= 8.31 J/mol-K.	**10**	**CO-5**
	SECTION-C		
Q-10	a) Draw a labeled time- temperature-transformation (TTT) curve and differentiate between TTT and CCT curve. Explain annealing, normalizing and quenching with the help of TTT diagram. **[12]** b) Write a short note on i) Tempered glass **[4]** ii) Thermoset and thermoplastic **[4]**	**20**	**CO4 & CO3**
Q-11	Pb melts at 620°F and Sn melts at 450°F. They form a eutectic containing 62% Sn at 360°F. The maximum solid solubility of Sn in Pb at this temperature is 19% (α phase); of Pb in Sn, 3% (β phase). Assume the solubility of each at room temperature is 1 percent. Answer the following. a) Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines, and areas. **[5]** 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 just below the eutectic temperature. **[5]** c) Draw the cooling curve for the above alloy. (Showing phases and degree of freedom at different temperature). **[4]** d) Find out the composition of alloy that will yield pro-eutectic β and total β weight	**20**	**CO-2**

	fraction of 0.23 and 0.65 respectively just below eutectic temperature. **[6]** **OR** A binary alloy having 28 wt % Cu & balance Ag solidifies at 779^{0}C. The solid consists of two pahses α & β. Phase α has 9% Cu whereas phase β has 8% Ag at 779^{0}C. At room temperature these are pure Ag & Cu respectively. Melting points of Cu & Ag are 1083^0 & 960^{0}C respectively. Answer the following a) Construct the phase diagram for this system on a piece of a graph paper and label each region. **[5]** 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. **[5]** c) Draw the cooling curve for above alloy (Showing phases and degree of freedom at different temperature). **[4]** 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. **[6]**		