Name:

Enrolment No:

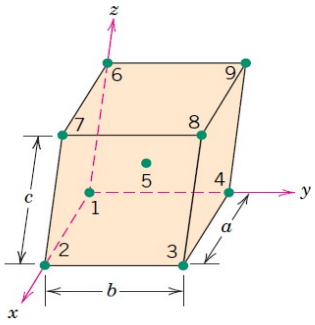
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Fundaments of Materials Science — **Semester: II**
Program: M.Sc. (Physics) — **Time: 03 hrs.**
Course Code: PHYS-7023 — **Max. Marks: 100**

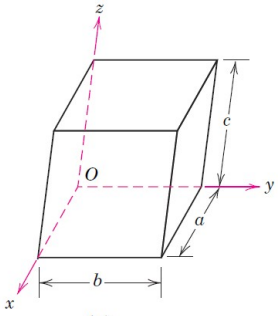
Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	1.1 What are the different types of possible bonding to form a compound? 1.2 What type(s) of bonding would be expected for each of the following materials: NaCl, CaF_2, SiC, Au, Ar, HF, and H_2O?	**2** **2**	**CO1**
Q 2	2.1 Specify coordinate indices for all numbered points (*i.e.*, 1 to 9) of the unit cell in the illustration: Point 1 is located at the origin of the coordinate system, and, therefore, its lattice position indices referenced to the *x*, *y*, and *z* axes are 0*a*, 0*b*, and 0*c*, respectively.	**2**	**CO1**
	2.2 Sketch the Miller planes: (100), (010), (110), and (111).	**2**	



Point Number	*q*	*r*	*s*
1			
2			
3			
4			
5			
6			
7			
8			
9			



Q 3	Define stress and strain? Draw a plot of stress-strain indicating the elastic deformation for loading and unloading cycles.	**4**	**CO3**
Q 4	Describe the conductors, semiconductors and insulators using energy band diagram?	**4**	**CO4**
Q 5	Explain heat capacity, thermal expansion and thermal conductivity?	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	6.1 Compute the average atomic weight for Cerium: Cerium has four naturally occurring isotopes: 0.185% of ^{136}Ce, with an atomic weight of 135.907 amu; 0.251% of ^{138}Ce, with an atomic weight of 137.906 amu; 88.450% of ^{140}Ce, with an atomic weight of 139.905 amu; and 11.114% of ^{142}Ce, with an atomic weight of 141.909 amu. Calculate the average atomic weight of Ce (in amu). 6.2 The atomic radii of K^+ and Br^- ions are 0.138 and 0.196 nm, respectively. a. Calculate the force of attraction between these two ions at their equilibrium interionic separation (i.e., when the ions just touch one another). b. What is the force of repulsion at this same separation distance?	**5** **5**	**CO1** **CO1**
Q 7	a. What is solid solution? State the Hume-Rothery rule? b. What are crystal imperfections and their types? What are point defects in metals and ceramics? What are dislocations?	**5** **5**	**CO2**
Q 8	8.1 When light impinges on a sheet of thickness t, what are different phenomenon that takes place, explain with the help of sketch. Write a relation for transmitted intensity I_T and explain the parameters. 8.2 What is the visible range (wavelength) in the electromagnetic spectrum? Calculate minimum and maximum possible band gap energy value for absorption of visible light by valence band-to-conduction band transition.	**6** **4**	**CO4**
Q 9	What is the reason for thermal expansion? Explain with the help of atomic perspective and plot of potential energy versus interatomic distance curve for solid material. **Or** What is Weidemann–Franz law for metals? A piece of copper originally 305 mm (12 in.) long is pulled in tension with a stress of 276 MPa (40,000 psi). If the deformation is entirely elastic, what will be the resultant elongation? The modulus of elasticity is 110 GPa (16×10^6 psi)	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Explain order and disorder, explain the ordered and disordered	**20**	**CO2**

	condition or transformation for Cu-Zn alloy (BCC system), and explain with the derivation to justify the difference.		
Q 11	Explain Binary Isomorphous Systems, how to interpret the phase diagram, what are the steps required to know the information available in the phase diagram? **Or** What do you understand from Binary Eutectic Systems? Explain it in brief using Cu-Ag phase diagram. Explain the eutectic reaction and its significance.	**20**	**CO2**