

Tribhuvan University

2080

Bachelor Level (4 Yrs.)/Science & Tech. / IV year
Material Science

Full Marks: 100
Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

PHY- 405 (New Course)

Attempt ALL the questions.

1. Discuss the different types of crystal structure. Also discuss stress strain nature of ceramics. [10]

OR

What is meant by lithography technique for material's synthesis? Explain with figures.

2. Explain the DoS Vs energy for 1 D, 2D and 3D with examples. [10]

OR

What are carbon nanotubes? Mention some of their properties and applications..

3. Why is it so important to control the rate of drying of a ceramic body that has been hydro plastically formed or slip cast? Cite three factors that influence the rate of drying and explain how each affect the rate. [8]

4. Discuss how material engineering can play a role in "green design". [8]

5. What do you mean by absorption of radiation? Explain the working mechanism of an optical fiber in communication. [8]

6. Discuss the working principle of light emitting diode. Write down the importance of polymeric substances. [8]

7. Answer all questions [2×3=6]

a) What do you mean by the term ferroelectricity and piezoelectricity?

OR

What is thermal conductivity? Explain the mechanism of heat conduction in conducting materials

- b). Make a comparative study of soft and hard magnetic materials on the basis of hysteresis characteristics.

OR

Define elastic and plastic deformation.

8. Answer all questions

[4×3=12]

- Differentiate between Infrared and Raman Spectroscopy.
- What is quantum dot laser?
- Discuss the fabrication of fibers in short.
- What do you mean by viscoelastic deformations? .

9. Show that the atomic packing factor for the Fcc crystal structure is

0.74.

[5]

10. Aluminium has Fcc crystal structure and an atomic radius of 0.1431 nm. Compute the interplanar spacing for the (110) and (221) set of planes.

[5]

11. Consider a parallel plate capacitor having an area of 2500 mm² and a plate separation of 2mm and with a material of dielectric constant 4.0 positioned between the plates

(a) What is the capacitance of this capacitor?

2

(b) Compute the electric field that must be applied for 80×10^{-9} Coulomb to be stored on each plate.

[5]

12. GaP has lattice constant of 0.545nm. Estimate the percent of atoms on surface for n= 2, 4, 25.

[5]

13. Zinc telluride (ZnTe) has a band gap of 2.26 eV. Over what range of wave lengths of visible light is it transparent?

[Given $h = 4.13 \times 10^{-15}$ eV-s and $C = 3 \times 10^8$ ms⁻¹]

[5]

14. A rod of some material 0.5m long elongates 0.40 mm on heating from 15°C to 50°C. What is the value of the linear coefficient of thermal expansion of this material?

[5]

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P.T.O.

Phy.- 405 (Old Course)

Attempt ALL the questions.

1. Discuss Gibbs phase rule by considering phase diagram of Ni - Cu. [10]:

OR

How do energy band structures in solids form? Discuss.

2. Describe electrical and mechanical properties of carbon nanotube. Hence explain its applications. [8]

OR

How do light interact with solid? Explain what is Laser? Discuss its importance.

3. What are different bonding forces and energies to form a solid? Explain. [8]
4. Discuss significance of x-ray diffraction to determine crystal structures. [8]
5. How do people fabricate fibers and films? Describe. [8]
6. What are different methods to synthesize nanoparticles? Explain one of them. [8]
7. Answer all questions: [2×3=6]
- a) Give the concept of potential well.

OR

Why recycling of materials is important?

- b) Explain stress-strain behaviour of polymers.

OR

What is crack? Define with examples.

8. Answer all questions [4×3=12]
- a. Define elastic deformation.
- b. Give details of modern materials need.
- c. Briefly describe arrangement of electrons in atoms.
- d. What is hardness? Define

9. Copper has an atomic radius of 1.28\AA (fcc structure). Its atomic wt. is 63.5 g/mol . Calculate its density. Avogadro number is 6.023×10^{23} atom/mol. [5]
10. The equilibrium number of vacancies in Ag at 800°C is $3.6 \times 10^{23}\text{ m}^{-3}$ (At wt = 107.9 gmol , $\rho = 9.5\text{g/cm}^3$). Calculate the energy for vacancy formation in Silver. [5]
11. Electrical conductivity and mobility of Ag (300K) are $3.8 \times 10^7\text{ }(\Omega\text{-m})^{-1}$ and $0.0012\text{m}^2/\text{V-S}$ respectively. Calculate no. of free electrons per m^3 in Ag. [5]
12. A coil of wire 0.30 m long and having 500 turns carries a current of 20A . Calculate the magnitude of magnetic field strength (H). [5]
13. A material has lattice constant of 3\AA . What percent of atoms will be on surface for $n = 20, 100, 1000, 10,000$? [5]
14. A rod has to be stress free in its use. The rod is stress free at 20°C . What is the maximum temp. to which the rod may be heated without exceeding a compressive stress of 172 MPa . Its modulus of elasticity is 100 GPa . [5]

