

Roll No



राष्ट्रीय प्रौद्योगिकी संस्थान गोवा NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa, 403401

Programme Name: B.Tech.

Mid Semester Examinations, June-2021

Course Name: Material Science

Date: 14/06/2021

Duration: 1 Hour 30 Minutes

Course Code: PH150

Time: 10.00 -11.30 AM

Max. Marks: 50

ANSWER ALL QUESTIONS

01. Determine the volume of an FCC unit cell in terms of the atomic radius R. 2 M
02. Explain why materials that are covalently bonded are less dense than those that are ionically or metallically bonded. 2 M
03. Explain why aluminium used in long distance transmission lines cannot be strengthened by solid solution. 2 M
04. Determine the interplanar spacing when a beam of X-ray of wavelength 1.54 \AA is directed towards the crystal at angle 30° to the atomic plane. 2 M
05. Define (i) space lattice (ii) basis 2 M
06. Calculate the Bragg angle if (111) planes of a cube ($a = 3.57 \text{ \AA}$) crystal are exposed to X-rays (wavelength = 1.54 \AA) 3 M
07. For a certain BCC crystal, the (110) plane has a separation of 1.181 \AA . These planes are indicated with X-ray of wavelength 1.540 \AA . Show that the maximum order of the Bragg's reflection that can be observed is $n = 1$. 3 M
08. Copper has a 0.128 nm atomic radius, an FCC crystal structure, and an atomic weight of 63.5 g/mol . Calculate the theoretical density of the copper 3 M
09. Draw [100], [110], and [111] directions within a unit cell. 3 M
10. Draw (0001), $(10\bar{1}1)$, and $(\bar{1}010)$ planes in the hexagonal crystal system 3 M
11. Is there any evidence of allotropy (or polymorphism) in noncrystalline materials? Is there any reason to believe that? 3 M
12. Calculate the conductivity of copper at 26.85°C . The collision time τ for electron scattering is $3 \times 10^{-14} \text{ s}$ at this temperature. 3 M
13. What is Bravais lattice? What is the maximum number of Bravais lattices possible? How will you account for the existence of thousands of structures from these lattices? 3 M
14. Explain Miller Bravais system? How is this system used to find the index of different planes? 3 M
15. Calculate the interplanar spacing and diffraction angle for the (220) set of planes for BCC iron. Fe has a lattice parameter of 0.2866 nm . Assume you're using monochromatic radiation with a wavelength of 0.1790 nm and a reflection order of 1. 4 M
16. A diffraction pattern of a cubic crystal of lattice parameter $a = 3.16 \text{ \AA}$ is obtained with a monochromatic X-ray beam of wavelength 1.54 \AA . The first line on this pattern was observed to have $\theta = 20.3^\circ$. Obtain the interplanar spacing and Miller indices of the reflecting plane. 4 M
17. Derive the kinetic energy of free electrons as a function of their wave number. 5 M

****ALL THE BEST ****