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15PHY12/22

**First/Second Semester B.E. Degree(CBCS)Examination****Engineering Physics**

Time: 3 hrs.

Max. Marks: 80

**Note: 1. Answer any FIVE full questions, choosing one full question from each module.****2. Physical Constants: Velocity of light,  $c = 3 \times 10^8$  m/s, Planck's constant,** **$h = 6.625 \times 10^{-34}$  JS; Mass of electron  $m = 9.1 \times 10^{-31}$  kg; Boltzmann constant,** **$k = 1.38 \times 10^{-23}$  J/K; Avagadro number,  $N_A = 6.02 \times 10^{26}$ /K mole****Module-1**

- 1
  - a. State Planck's law of black body radiation. Show that Planck's law reduces to Wien's law and Rayleigh Jeans law at lower and higher wavelength limits respectively. (07 Marks)
  - b. Based on Heisenberg's uncertainty principle, show that electrons cannot exist within the nucleus. (05 Marks)
  - c. Calculate the de Broglie wavelength of an electron moving with a K.E. of 50 Kev. (04 Marks)

**OR**

- 2
  - a. What is phase velocity and group velocity? Show that group velocity is equal to particle velocity. (05 Marks)
  - b. Obtain the solution of Schrodinger's time independent wave equation for a particle in a one dimensional potential box of infinite height. (07 Marks)
  - c. X-rays of wavelength  $0.75 \text{ \AA}$  are scattered from a target at an angle of  $45^\circ$ . Calculate the wavelength of scattered X-rays. (04 Marks)

**Module-2**

- 3
  - a. What is Fermi level? Describe the variation of Fermi factor with temperature. (05 Marks)
  - b. What is Meissner effect? Write a note on Type – I and Type – II super conductors. (07 Marks)
  - c. For intrinsic gallium arsenide, the room temperature electrical conductivity is  $10^{-6} \text{ ohm}^{-1} \text{ m}^{-1}$ . The electron and hole mobilities are respectively  $0.85 \text{ m}^2/\text{Vs}$  and  $0.04 \text{ m}^2/\text{Vs}$ . Calculate the intrinsic carrier concentration at room Temperature. (04 Marks)

**OR**

- 4
  - a. Explain the BCS theory of super conductivity. (05 Marks)
  - b. State law of mass action. Obtain an expression for the intrinsic carrier density. (07 Marks)
  - c. Calculate the probability of finding an electron at an energy level  $0.02 \text{ eV}$  above Fermi level at  $300\text{K}$ . (04 Marks)

**Module-3**

- 5
  - a. Explain the construction and working of carbon dioxide Laser. (08 Marks)
  - b. Obtain an expression for the numerical aperture of an optical fiber. (04 Marks)
  - c. The average power output of a laser beam of wavelength  $6500 \text{ \AA}$  is  $10 \text{ mw}$ . Find the number of photons emitted per second by the laser source. (04 Marks)

**OR**

- 6
  - a. What is holography? Explain the principle and method of recording an image on a hologram. (06 Marks)
  - b. Explain the different types of optical fibers. (06 Marks)
  - c. An Optical signal propagating in a fiber retains  $85\%$  of input power after travelling a distance of  $500 \text{ m}$  in the fiber. Calculate the attenuation coefficient. (04 Marks)

**Module-4**

- 7 a. Obtain an expression for the inter planar distance in a cubic crystal in terms of Miller indices. (05 Marks)
- b. What is atomic packing factor? Calculate the atomic packing factor for SC, FCC and BCC structures. (07 Marks)
- c. First order spectrum is formed when X - rays of wavelength  $1.5 \text{ \AA}$  is incident on a crystal at a glancing angle of  $12^\circ$ . Calculate the inter planar distance. If the Miller indices of the plane is  $(1\ 0\ 1)$ , then find the lattice constant. (04 Marks)

**OR**

- 8 a. With the help of a neat diagram explain the crystal structure of diamond and calculate its atomic packing factor. (06 Marks)
- b. Explain allotropy and polymorphism. (06 Marks)
- c. Draw the crystal planes  $(1\ 2\ 0)$  and  $(1\ 0\ 1)$  in a cubic crystal. (04 Marks)

**Module-5**

- 9 a. What is Mach number? Explain the difference between ultra sonic and acoustic Waves? (04 Marks)
- b. What is a carbon nano tube? Explain how it is synthesized using pyrolysis method. (06 Marks)
- c. Explain the working of SEM with the help of a neat diagram. (06 Marks)

**OR**

- 10 a. Briefly explain the Rankine – Hugonit shock equations. (05 Marks)
- b. Explain the Sol - Gel method of synthesis of nano materials. (07 Marks)
- c. Write a note on applications of carbon nano tubes. (04 Marks)

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