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17PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2019/Jan.2020 Engineering Physics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer FIVE full questions, choosing ONE full question from each module.

**2. Physical constants : $h = 6.624 \times 10^{-34} \text{ JS}$, $K = 1.38 \times 10^{-23} \text{ J/K}$,
 $N_A = 6.022 \times 10^{23} / \text{mole}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$.**

Module-1

- 1 a. Define phase velocity and group velocity. Derive the relation between them. (06 Marks)
- b. Derive the expression for Eigen function and energy Eigen values for a particle inside a potential well of infinite height. (07 Marks)
- c. Explain Heisenberg's uncertainty principle. Mention its physical significance. (03 Marks)
- d. Find the kinetic energy and group velocity of an electron with De-Broglie wavelength of 0.2 nM. (04 Marks)

OR

- 2 a. What are the assumptions of Plank's law of radiation? Derive Wien's law and Rayleigh-Jean's law from Planck's law. (07 Marks)
- b. Set up one dimensional time independent Schrodinger wave equation. (06 Marks)
- c. What are matter waves? Give its properties. (03 Marks)
- d. A spectral line of wavelength 546 nm has a width of 10^{-14} m. Evaluate the minimum time spent by the electron in the upper energy state between the excitation and deexcitation processes. (04 Marks)

Module-2

- 3 a. Explain failure of classical free electron theory. (06 Marks)
- b. Discuss BCS theory of super conductivity. (06 Marks)
- c. Explain Meissner effect. (04 Marks)
- d. Calculate the number of donor atoms which must be added to an intrinsic semiconductor to obtain a conductivity of 2.2×10^{-4} mho/m. Given mobility of electrons = $125 \times 10^{-3} \text{ m}^2/\text{VS}$. (04 Marks)

OR

- 4 a. Derive the expression for electrical conductivity of an intrinsic semiconductor. (06 Marks)
- b. Define critical temperature and critical field for superconductivity. Explain temperature dependence of critical field. (06 Marks)
- c. Define the terms : (i) Drift velocity (ii) Thermal velocity (iii) Relaxation time (iv) Mean collision time. (04 Marks)
- d. Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi level is occupied. (04 Marks)

Module-3

- 5 a. What is attenuation in optical fibers? Give the equation for attenuation coefficient. Explain different attenuation mechanisms. (07 Marks)
- b. Derive an expression for energy density in terms of Einstein's coefficients. (06 Marks)
- c. Write a note on modes of propagation and V.number in optical fiber. (04 Marks)
- d. The average output power of a laser emitting photons of wavelength 632.8 nm is 5 mW. Calculate the number of photons emitted per second by the laser beam. (03 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



OR

- 6 a. Describe the construction and working of a semiconductor diode laser. (06 Marks)
b. Explain different types of optical fibers with suitable diagrams. (06 Marks)
c. Mention the properties of laser light. (04 Marks)
d. The attenuation of light in an optical fiber is 2.2 dB/km. If the input power is 100 MW. Calculate the output power after 2 km and 6 km. (04 Marks)

Module-4

- 7 a. Define packing factor. Obtain packing factor for simple cubic, bcc and fcc structures. (07 Marks)
b. What is Bragg's law? Describe how Bragg's spectrometer is used to determine the wavelength of X rays. (06 Marks)
c. Define allotropy and polymorphism. (03 Marks)
d. Draw the following planes in a cubic unit cell:
(i) 100 (ii) (101) (iii) (111) (iv) (132) (04 Marks)

OR

- 8 a. What are Miller indices? Explain the procedure to find Miller indices of a plane with an example. (06 Marks)
b. Derive an expression for interplanar distance for a set of parallel planes having Miller indices (hkl). (06 Marks)
c. Discuss Perovskite structure. (04 Marks)
d. A monochromatic X ray beam of wavelength 0.7 Å undergoes first order Bragg reflection from (302) plane of a cubic crystal at a glancing angle of 35°. Calculate the lattice constant. (04 Marks)

Module-5

- 9 a. Define: (i) Mach number (ii) Subsonic wave (iii) Supersonic wave (iv) Hypersonic wave (iv) Mach angle. (05 Marks)
b. Give an account of Rankine-Hugoniot equations and mention the conservation laws. (06 Marks)
c. Discuss Ball milling method of synthesis of nanoparticles. (05 Marks)
d. What are carbon nanotubes? Mention their properties. (04 Marks)

OR

- 10 a. Describe the construction and working of Reddy tube. (07 Marks)
b. Describe the principle, construction and working of scanning electron microscope. Mention its applications. (08 Marks)
c. Describe arc discharge method of obtaining CNTs with the help of a diagram. (05 Marks)
