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14PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2015

Engineering Physics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE questions, selecting ONE full question from each part.*
2. Physical constants : Velocity of light, c = 3 x 10 ^{8} mis; Planck's constant, h = 6.63 x 10^{-34} Js ; Mass of electron, m = 9.1 x 10 $^{-31}$kg; Charge of electron, e =1.6 x 10^{-19} C ; Boltzmann's constant, k = 1.38x 10 $^{-23}$ PK.

PART — A

1 a. Write the assumptions of quantum theory of radiation and deduce Rayleigh-Jeans law from Planck's law. (05 Marks)
b. Give four important properties of matter waves. (04 Marks)
c. Set up time independent Schrodinger wave equation in one dimension. (07 Marks)
d. Calculate the energy in eV, for the first excited state of an electron in an infinite potential well of width 2 Å. (04 Marks)

2 a. State de Broglie hypothesis and show that the group velocity of the de Broglie waves of a particle is equal to the velocity of the particle. (05 Marks)
b. State and explain Heisenberg's uncertainty principle. (05 Marks)
c. Explain in brief the properties of wave function. If the wave function of a particle in an infinite potential box of width 'a' is i = B sin Orr xla) where x is the position and n is the quantum number, find B. (06 Marks)
d- The wavelength of a fast neutron of mass 1.675 x 10^{-27} kg is 0.02nm. Calculate the group velocity and the phase velocity of its de Broglie waves. (04 Marks)

PART — B

3 a. Obtain an expression for the conductivity of a metal from quantum mechanical considerations. (06 Marks)
b. Show that the Fermi level of an intrinsic semiconductor lies in the middle of the forbidden energy gap. (05 Marks)
c. Explain the temperature dependence of resistivity of metal and state Matthiessen's rule. (05 Marks)
d. Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 300k. (04 Marks)

4 a. Define the terms drift velocity, mean path, mean collision time and relaxation time. (04 Marks)
b. Explain Hall effect. Arrive at the equation for Hall coefficient in terms of Hall voltage and current through the specimen. (08 Marks)
c. Describe Maglev vehicle. (04 Marks)
d. Calculate the concentration at which the acceptor atoms must be added to a germanium sample to get a p — type semiconductor with conductivity 0.15 per ohm-metre. Given the mobility of holes = 0.17 m^{2}/Vs. (04 Marks)

PART — C

5 a. Derive an expression for the radiant energy density under thermal equilibrium using Einstein's coefficients. (07 Marks)

b. With suitable ray-diagrams, explain the principle construction of a holographic images. (05 Marks)

c. Give an account of point to point communication system using optical fibers. (04 Marks)

d. The angle of acceptance of an optical fiber kept in air is 30°. Find the angle of acceptance when the fiber is in a medium of refractive index 4/3. (04 Marks)

6 a. Discuss the requisites and the conditions for a laser system. (06 Marks)

b. Define angle of acceptance and numerical aperture. Obtain an expression for the numerical aperture of an optical fiber. (06 Marks)

c. Explain measurement of pollutant in atmosphere using lasers. (04 Marks)

d. A 5W pulsed laser emits light of wavelength 694 nm. If the duration of each pulse is 2Ons, Calculate the number of photons emitted per pulse. (04 Marks)

PART —D

7 a. Mention the geometrical configurations of the seven crystal systems. (07 Marks)

b. Sketch and describe the Perovskite structure. (05 Marks)

c. Derive Bragg's equation. (04 Marks)

d. The atomic radius of gold is 0.144nm. Determine the interplanar distance for (110) planes assuming that gold belongs to FCC system. (04 Marks)

8 a. With the help of vector diagram explain the terms basis vectors, lattice vector, interfacial angles and crystal parameters of a space lattice. (06 Marks)

b. Derive an expression for interplanar distance in terms of Miller indices. (05 Marks)

c. Define coordination number and packing factor. Compute the packing factor for BCC crystals. (05 Marks)

d. In a calcite crystal, second order Bragg's reflections occur from the planes with d-spacing 3 Å, at a glancing angle of 24°. Calculate the path difference between x-rays reflected from the two adjacent planes. Also, Calculate the wavelength of the x-rays. (04 Marks)

PART —E

9 a. Define shock waves. Mention its properties. (06 Marks)

b. What are nanomaterials? Outline the structure of a carbon nano tube. (06 Marks)

c. What is a scanning electron microscope? Mention its three applications. (04 Marks)

d. The distance between the two pressure sensors in a shock tube is 100mm. The time taken by a shock wave to travel this distance is 200 microsecond. If the velocity of sound under the same conditions is 340 m/s, find the Mach number of the shock wave. (04 Marks)

10 a. Define Mach number, subsonic waves and supersonic waves. (03 Marks)

b. Discuss the basics of conservation of mass, momentum and energy. (09 Marks)

c. Explain the sot-gel method of preparing nanomaterials. (04 Marks)

d. In a scanning electron microscope, electrons are accelerated by an anode potential difference of 60 kilo volt. Estimate the wavelength of the electrons in the scanning beam. (04 Marks)

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