

CBCS SCHEME

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17PHY12/22

First/Second Semester B.E. Degree Examination, Feb./Mar. 2022 Engineering Physics

Time: 3 hrs.

Max. Marks: 100

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

Boltzmann's constant, $k = 1.38 \times 10^{-23}$ J/k

Avadro's no, $N_A = 6.023 \times 10^{26}$ /Kmole

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg

Mass of neutron, $m_n = 1.675 \times 10^{-27}$ kg

Charge of electron = 1.6×10^{-19} C.

Module-1

- 1 a. Describe the assumptions of Planck's law of Black-body radiation. Show that this law can be reduced to Wien's law and Rayleigh law under certain condition. (06 Marks)
- b. Explain Compton effect and its physical significance. (04 Marks)
- c. Using Heisenberg uncertainty principle show that electron do not exists inside the nucleus. (06 Marks)
- d. An electron is bound in one dimensional potential well of width 2 \AA , but of infinite height. Find its energy value in 'eV' in the ground state and first two excited state. (04 Marks)

OR

- 2 a. Define group velocity. Establish that group velocity of the de-Broglie's wave of a particle is equal the velocity of particle. (05 Marks)
- b. Define wave function. Explain its physical significance. (04 Marks)
- c. Obtain energy eigen value and eigen function for an electron in one dimensional potential well of width 'a' and infinite height using one dimensional time independent Schrodinger wave equation. (08 Marks)
- d. Calculate the de-Broglie wavelength associated with electron accelerated through a potential difference of 1.5eV. (03 Marks)

Module-2

- 3 a. Define relaxation time and density of states. (04 Marks)
- b. Derive the expression for electrical conductivity taking into account the quantum theory of free electron. (08 Marks)
- c. Explain superconductivity and discuss Meissner effect. (05 Marks)
- d. If the mobilities of electron and holes in an intrinsic semiconductor at 300K are 0.36 and $0.14 \text{ m}^2/\text{v-s}$ respectively. Calculate the roof intrinsic charge carriers present in it, given conductivity (σ) = $2.2/\text{ohm-m}$. (03 Marks)

OR

- 4 a. Describe the merits of quantum free electron theory. (06 Marks)
- b. State law of mass action. Derive the expression for conductivity of an intrinsic semiconductor. (05 Marks)
- c. Define type I and type II superconductors. Mention its application. (06 Marks)
- d. Calculate the relaxation time of conduction electrons in a metal of resistivity 1.92×10^{-8} ohm-m, if the metal contains 5.8×10^{28} es/m³. (03 Marks)

Module-3

- 5 a. Explain the terms population inversion and metastable state for achieving laser beam. (04 Marks)
- b. Explain the different vibrational state of CO₂ molecules. Describe the construction and working of CO₂ laser. (08 Marks)
- c. With neat diagram obtain the expression for numerical aperture and condition for propagation of light in an optical fibre. (05 Marks)
- d. Calculate V-number R-Number of modes for a fiber of core diameter 50 μm with refractive indices 1.50 and 1.48 respectively for core and cladding. The wavelength of the light propagating through fibre is 1 μm. (03 Marks)

OR

- 6 a. Write a brief note on laser welding, cutting and drilling. (06 Marks)
- b. With neat sketch describe the types of optical fibre. (06 Marks)
- c. Derive the expression for attenuation coefficient of an optical fibre. (04 Marks)
- d. The average power of laser beam of wavelength is 6328 Å is 8mW. Find the number of photons emitted per second by the source. (04 Marks)

Module-4

- 7 a. Obtain the expression for interplanar spacing in a crystal in terms of Miller indices. (06 Marks)
- b. With neat diagram, explain the structure of a diamond crystal. (06 Marks)
- c. Draw the following planes:
i) (0 1 0) ii) (0 2 1) iii) (1 1 1) iv) ($\bar{2}$ 1 0) (04 Marks)
- d. Find the miller indices of the plane making an intercept of $6\bar{a} : 5\bar{b} : 8\bar{c}$ on x:y:z axis. Where \bar{a} , \bar{b} and \bar{c} are primitive vector. (04 Marks)

OR

- 8 a. Define:
i) Unit cell and lattice parameter
ii) Bravis and Non-Bravis lattice
iii) Primitive and non primitive unit cell with neat figure. (06 Marks)
- b. Obtain packing factor of sc, bcc and fcc structure after obtaining the relation between lattice constant 'a' and atomic radius 'R'. (06 Marks)
- c. Define Miller indices and explain the procedure to find it. (04 Marks)
- d. Calculate the glancing angle of incidence of x-rays of wavelength 0.58 Å on the plane (132) of NaCl, which results in 2nd order diffraction maxima, taking the lattice constant as 3.81 Å. (04 Marks)

Module-5

- 9 a. Define Mach number. Explain the basic laws of conservation of mass, momentum and energy. (07 Marks)
- b. Discuss the density of states in 1D, 2D and 3D structures. (06 Marks)
- c. Explain carbon nanotube and its structure. Mention few applications of it. (07 Marks)

OR

- 10 a. Discuss shock wave. Distinguish between acoustic, ultrasonic, subsonic and supersonic waves. (06 Marks)
- b. With neat diagram describe the hand operated Reddy shock tube and its characteristics. (08 Marks)
- c. Describe top down and Bottom-up approach for the synthesis of nano-particles. Discuss ball-milling method. (06 Marks)
