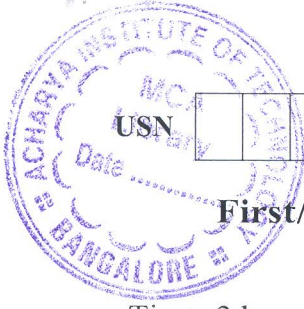


# CBCS SCHEME

15PHY12/22



USN

First/Second Semester B.E. Degree Examination, Jan./Feb. 2023

## Engineering Physics

Time: 3 hrs.

Max. Marks: 80

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

2. Physical Constants: Planck's constant:  $= 6.63 \times 10^{-34} \text{ J.S}$   
Mass of electron :  $9.1 \times 10^{-31} \text{ kg}$   
Boltzmann constant:  $1.38 \times 10^{-23} \text{ J/K}$ ,  
Avogadro number:  $6.025 \times 10^{26} \text{ /Kmol}$ ,  
Velocity of light:  $3 \times 10^8 \text{ m/s}$

### Module-1

- 1 a. Setup time independent Schrödinger wave equation for motion of a particle in one dimension. (07 Marks)  
b. Explain Compton's scattering. Give its physical significance. (05 Marks)  
c. Compare the Kinetic energies of a electron and a neutron when both are associated with same wavelength. Given  $m_n = 1.675 \times 10^{-27} \text{ Kg}$  and  $m_e = 9.1 \times 10^{-31} \text{ kg}$ . (04 Marks)

OR

- 2 a. What is a wave function? Explain the physical meaning of wave function. Mention the properties of proper wave function. (07 Marks)  
b. Define phase velocity and group velocity. Derive the relation between phase velocity and group velocity. (05 Marks)  
c. The uncertainty in the measurement of position of an electron is equal to its deBroglie's, wavelength. Determine the uncertainty in its, momentum. (04 Marks)

### Module-2

- 3 a. Explain how Quantum free electron theory overcomes the draw backs of classical free electron theory. (06 Marks)  
b. Explain BCS theory of superconductivity. (06 Marks)  
c. Calculate the probability of an electron occupying an energy level 0.02eV above Fermi level at 200K and 400K in a material. (04 Marks)

OR

- 4 a. List out the similarities and differences between classical free electron theory and Quantum free electron theory. (06 Marks)  
b. Explain the law of mass action. Derive the expression for conductivity of an intrinsic semiconductor. (06 Marks)  
c. The resistivity of intrinsic silicon at 27°C is  $3000 \Omega \text{m}$ , Assuming electron and hole mobilities of 0.17 and  $0.035 \text{ m}^2/\text{ Volt.sec}$  respectively, calculate the intrinsic carrier concentration at 27°C. (04 Marks)

**Module-3**

- 5 a. Describe the construction and working of semiconductor laser. (06 Marks)  
 b. Derive the expression for energy density in terms of Einstein's coefficients. (06 Marks)  
 c. Calculate acceptance angle, Numerical aperture V-number and no. of modes in an optical fibre of core radius  $50\mu\text{m}$ , core and cladding refractive indices 1.41 and 1.4 at wavelength  $8400\text{\AA}$ . (04 Marks)

**OR**

- 6 a. Explain the types of optical fibres with neat diagrams. (06 Marks)  
 b. Describe the construction and working of  $\text{CO}_2$  laser. (06 Marks)  
 c. Find the number of modes of the standing waves and their frequency separation in a resonant cavity of length 5 meters of a laser source operating at wavelength  $6328\text{\AA}$ . (04 Marks)

**Module-4**

- 7 a. Define Miller indices. Derive the expression for interplanar spacing in terms of Miller indices for cubic system. (07 Marks)  
 b. Write a note on Perovskites. (05 Marks)  
 c. A X-ray beam of wavelength  $0.7\text{\AA}$  undergoes first order Bragg reflection from the plane (302) of a simple cubic crystal at a glancing angle  $35^\circ$ . Determine the Atomic radius. (04 Marks)

**OR**

- 8 a. State Bragg's law. Determine interplanar spacing of a cubic structure using Bragg's spectrometer. (06 Marks)  
 b. Explain the terms :  
 i) Space lattice ii) Allotropy iii) Polymorphism. (06 Marks)  
 c. Draw the following planes in a simple cubic unit cell.  
 $(0\bar{1}0)$ ,  $(110)$ ,  $(1\bar{2}3)$ ,  $(\bar{1}\bar{1}0)$ . (04 Marks)

**Module-5**

- 9 a. What are carbon nanotubes? Describe the arc-discharge method of producing carbon nanotubes. (06 Marks)  
 b. Discuss the construction and working of a Reddy shock tube with necessary diagrams. (06 Marks)  
 c. Give the graphical representation of density of states for 0D, 1D, 2D and 3D structures. (04 Marks)

**OR**

- 10 a. Describe the principle, construction and working of scanning electron microscope. (07 Marks)  
 b. Describe Sol-gel method of preparation of nanomaterials with necessary diagrams. (04 Marks)  
 c. The distance between two pressure sensors in a shock tube is 100mm. The time taken by a shock wave to travel this distance is  $100\mu\text{s}$ . If the velocity of the sound under same conditions is 340m/s, find shock speed and Mach number of the shock wave? (05 Marks)

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