

CBCS SCHEME

18PHY12/22



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

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Physical constants : $h = 6.625 \times 10^{-34}$ JS, $e = 1.602 \times 10^{-19}$ C, $K = 1.38 \times 10^{-23}$ J/K⁻¹,
 $m_e = 9.1 \times 10^{-31}$ kg, $c = 3 \times 10^8$ ms⁻¹, $g = 9.8$ ms⁻²
3. Use sketches and figures wherever necessary.

Module-1

- 1 a. Explain Mechanical Simple Harmonic Oscillator and setup differential Equation for free oscillations starting from Hooke's law. (08 Marks)
b. What is a shock tube? Explain the construction and working of Reddy shock tube. (07 Marks)
c. A mass of 1Kg is attached to a massless spring with spring constant $4\pi^2$ Nm⁻¹ and is executing free oscillations. Calculate the natural frequency of the spring mass system. If the spring mass system is set to forced oscillations using a 1Hz source state the condition of forced oscillations. (05 Marks)

OR

- 2 a. Discuss the Theory of Forced oscillators. (10 Marks)
b. Enumerate the properties of shock waves. (05 Marks)
c. Compare the Mach number of a bullet moving with a velocity 400ms⁻¹ with a jet fighter traveling with a velocity 900km/hour given the velocity of sound in the medium 333ms⁻¹. (05 Marks)

Module-2

- 3 a. Explain Hooke's law of elasticity and explain stress Vs strain curve for an elastic material. (07 Marks)
b. Define Bending moment. Derive an expression for Bending moment of an uniform bar of Rectangular cross section. (08 Marks)
c. Given the Rigidity modulus of steel 80GPa, calculate the bulk modulus give the Poisson's ratio for steel 0.2. (05 Marks)

OR

- 4 a. Explain the three types of stresses and strains. (06 Marks)
b. Define couple per unit twist for the torsion of cylinder. Derive an expression for couple per unit twist for an uniform wire of circular cross-section. (09 Marks)
c. Determine the extension in a steel wire of length 2m and radius 1mm fixed rigidity to the ceiling and loaded at the other and with a mass of 5kg given Young's modulus of steel 210GPa. (05 Marks)

Module-3

- 5 a. Define Acceptance angle and Numerical aperture of an optical fiber and Derive an expression for Numerical Aperture with a neat ray diagram. (07 Marks)
- b. Elucidate the equation of continuity and Derive Maxwell-Ampere law. (08 Marks)
- c. Given $\vec{A} = (3x^2 - y + az)\hat{i} + (bx - 5y^2 - 2z)\hat{j} + (2x + cy + 3z)\hat{k}$.
Find a, b, c if \vec{A} is irrotational. (05 Marks)

OR

- 6 a. Define Displacement current Density and Derive an expression for displacement current using a simple AC circuit containing a capacity and an AC source. (07 Marks)
- b. Starting with Maxwell's equations arrive at the wave equation for electromagnetic waves in Vacuum in terms of electric field. (08 Marks)
- c. Given the RI of core and cladding of an optical fiber are 1.5 and 1.49 respectively. Calculate the Numerical Aperture, Acceptance Angle and Fractional RI change in the fiber is replaced in air. (05 Marks)

Module-4

- 7 a. Mention any Five properties of matter waves. (05 Marks)
- b. Mention the requisites of a laser system and explain the construction and working of carbon dioxide LASER with the help of neat sketches. (10 Marks)
- c. Compare the de Broglie wavelength of an electron accelerated through a potential difference of 182V with that of an object of mass. 1 Kg moving with a speed of 1ms^{-1} . (05 Marks)

OR

- 8 a. Briefly explain the applications of LASER in Defense. (05 Marks)
- b. Discuss the motion of a particle in an one dimensional potential well of infinite height and of width 'a'. (10 Marks)
- c. Find the ratio of population of two energy levels in a medium at thermal equilibrium, if the wavelength of light emitted at 291K is 6928Å . (05 Marks)

Module-5

- 9 a. Define Fermi energy and density of states and derive an expression for Fermi energy at 0K. (08 Marks)
- b. Derive an expression for the electrical conductivity in semiconductors. (07 Marks)
- c. The electron and Hole mobilities of silicon are $0.15\text{m}^2\text{V}^{-1}\text{s}^{-1}$ and $0.04\text{m}^2\text{V}^{-1}\text{s}^{-1}$ respectively at a certain temperature. If the free e^- concentration in silicon is 1.5×10^{16} electrons m^{-3} calculate the resistivity of silicon. (05 Marks)

OR

- 10 a. Define Polar and non-polar dielectrics. Explain the types of polarization mechanisms. (08 Marks)
- b. Mention the failures of classical free electron theory of metals and explain the success of Quantum free electron theory of metals. (07 Marks)
- c. The Fermi Level for Silver (A_g) is 5.5eV what is the probability of occupancy at 300K is 0.01. (05 Marks)
