

CBCS SCHEME

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18PHY12/22

First/Second Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 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

$$C = 3 \times 10^8 \text{ m/s,}$$

$$K = 1.38 \times 10^{-23} \text{ J/K,}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg,}$$

$$h = 6.625 \times 10^{-34} \text{ JS,}$$

$$N_A = 6.02 \times 10^{26} / \text{K mole,}$$

$$e = 1.6 \times 10^{-19} \text{ C.}$$

Module-1

- 1 a. What are Shock Waves? List any 5 application of shock waves. (06 Marks)
- b. Derive the expression for equivalent force constant for 2 springs connected in series and parallel and hence write the expression for period of its oscillations. (10 Marks)
- c. A mass 0.5 kg causes an extension 0.03 m in a spring and the system is set for oscillations. Find : i) Force constant K of the spring ii) Angular frequency W. (04 Marks)

OR

- 2 a. Define Simple Harmonic Motion. Derive the differential equation for simple harmonic motion using Hooke's law. (06 Marks)
- b. Describe the construction and working of Reddy's shock tube and also mention any three properties of shock waves. (10 Marks)
- c. A free particle is executing simple harmonic motion in a straight line. The minimum velocity it attains during any oscillation is 62.8 ms^{-1} . Find the frequency of oscillation if its amplitude is 0.5m. (04 Marks)

Module-2

- 3 a. Explain the stress-strain curve with a neat diagram. (05 Marks)
- b. Derive the relation between y , x and σ where the symbols have their usual meaning. (06 Marks)
- c. What is Torsional Oscillation? Give the expression for time period of torsional oscillation. Mention the applications of them. (05 Marks)
- d. Calculate the extension produced in a wire of length 2m and radius $0.013 \times 10^{-2} \text{ m}$ due to a force of 14.7 N applied along the length. Given Young's modulus of the material of the wire, $Y = 2.1 \times 10^{11} \text{ N/m}^2$. (04 Marks)

OR

- 4 a. State and explain Hooke's Law. Define rigidity and bulk modulus. (06 Marks)
- b. Obtain an expression for bending moment of a bar with rectangular cross section. Use the above expression to arrive the equation for depression at the loaded end of a single cantilever. (10 Marks)
- c. A wire of length 2m and radius 2mm is fixed to the center of a wheel. A torque of magnitude 0.0395 Nm is applied to twist the wire. Find the rigidity modulus of the wire if the angular twist is 0.038 rad. (04 Marks)

Module-3

- 5 a. Explain linear surface and volume integrations. (06 Marks)
- b. Obtain an expression for displacement current. (05 Marks)
- c. Explain briefly the Faraday's Law of electromagnetic induction. (05 Marks)
- d. An optical fiber has the refractive index 1.5 and cladding refractive index 3% less than that of core. Calculate numerical aperture. (04 Marks)

OR

- 6 a. Give the 4 Maxwell's equations in differential form in vacuum and hence derive the T2M wave equation in term of electric field using Maxwell's equations. (10 Marks)
- b. Obtain the expression for attenuation co-efficient of an optical fiber. (06 Marks)
- c. Calculate the divergence of \vec{D} at the point if $\vec{D} = \frac{1}{z^2} [10xyz \hat{a}_x + 5x^2z \hat{a}_y + (2z^3 - 5x^2y) \hat{a}_z]$ at a point P[-2, 3, 5]. (04 Marks)

Module-4

- 7 a. Set up one dimensional time independent Schrödinger wave equation. (06 Marks)
- b. With a neat energy level diagram, explain the construction and working of CO₂ laser. (10 Marks)
- c. Estimate the potential difference through which a Proton is needed to be accelerated so that its de-broglie wavelength becomes equal to 1 Å, given its mass is 1.673×10^{-27} kg. (04 Marks)

OR

- 8 a. With a proper energy level diagram, explain the working of semi conductor laser. Explain how data storage is achieved in a compact disc. (10 Marks)
- b. Using uncertainty principle, show that a free electron cannot exist within the nucleus of an atom (06 Marks)
- c. Find the ratio of population of the 2 states in a He - Ne laser that produces a light of wavelength 6328 \AA at 27°C . (04 Marks)

Module-5

- 9 a. With any one specific case, explain how quantum free electron theory succeeds in overcoming the draw backs of classical free electron theory. (04 Marks)
- b. Discuss the 3 polarization mechanism in dielectrics. (06 Marks)
- c. Define Fermi Factor. Explain the variation of Fermi Factor with temperature. (06 Marks)
- d. The resistivity of intrinsic silicon at 27°C is 3000 \Omega m . Assuming electron and hole mobilities of silicon as $0.17 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$ and $0.035 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$ respectively. Calculate the intrinsic carrier concentration at 27°C . (04 Marks)

OR

- 10 a. Give the assumptions of quantum free electron theory and hence obtain the expression for Fermi energy at 0 K. (08 Marks)
- b. Define Internal field in case of solid dielectric. Derive Clausius – Morsotti equation. (08 Marks)
- c. Find the electron density for metal with Fermi energy of 3eV . (04 Marks)
