

CBCS SCHEME

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18PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2024 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 : $C = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ Js, $g = 9.8$ m/s², $e = 1.6 \times 10^{-19}$ C,
 $N_A = 6.02 \times 10^{26}$ /K mole, $k = 1.38 \times 10^{-23}$ J/K*

Module-1

- 1 a. What is forced oscillations? Derive an expression for amplitude and phase in forced oscillations. (10 Marks)
- b. Distinguish between acoustic wave, subsonic wave, supersonic wave and ultrasonic wave. (06 Marks)
- c. The distance between the two pressure sensors in a shock tube is 150mm. The time taken by a shock wave to travel this distance is 0.3 ms. If the velocity of the sound under the same conditions is 340 m/s, find the Mach number of the shock wave. (04 Marks)

OR

- 2 a. Derive the expression for equivalent force constant for two springs connected in series and parallel. (10 Marks)
- b. Define Simple Harmonic Motion. Write the characteristics of Simple Harmonic Motion. (06 Marks)
- c. A man weighing 600N steps on a spring scale machine. The spring in the machine is compressed by 1cm. Find the force constant of the spring and angular frequency if the system is set for oscillations. (04 Marks)

Module-2

- 3 a. Define bending moment. Derive the expression for bending moment in terms of moment of inertia. (10 Marks)
- b. Explain tensile stress and compressive stress. What are the engineering importance of elastic materials. (06 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)

OR

- 4 a. Derive the relation between Y , η and σ where Y is Young's modulus, η is rigidity modulus and σ - Poisson's ratio. (10 Marks)
- b. State and explain Hooke's law. Define elastic and plastic limit. (06 Marks)
- c. Calculate the extension produced in a wire of length 2m and radius of steel wire of 0.013×10^{-2} m due to a force of 14.7 N applied along its length. Given : Young's modulus of the material of the wire, $Y = 2.1 \times 10^{11}$ N/m². (04 Marks)

Module-3

- 5 a. What is attenuation in an optical fiber? Mention the factors contributing to the fiber losses. (10 Marks)
- b. Explain the terms gradient of a scalar divergence and curl of a vector. (06 Marks)

- c. Find the divergence of the vector field \vec{A} given by $\vec{A} = 6x^2\hat{a}_x + 3xy^2\hat{a}_y + yz^3\hat{a}_z$ at a point P(1, 3, 6) (04 Marks)

OR

- 6 a. Explain the terms: Modes of propagation acceptance angle, numerical aperture and derive an expression for numerical aperture of an optical fiber. (10 Marks)
 b. What is displacement current? Derive the expression for displacement current. (06 Marks)
 c. A fiber of 500m long is having an input power of 100mW and output power of 90 mW. What is its attenuation? (04 Marks)

Module-4

- 7 a. State de-Broglie hypothesis. Show that an electron can't exist in the nucleus of an atom (relativistic case / non relativistic case). (10 Marks)
 b. Elaborate the construction and working of a semiconductor laser. (06 Marks)
 c. Find the ratio of population of the two energy states of a medium in thermal equilibrium the transition between which results in the spontaneous emission of photons of wavelength 694.3 nm. Assume ambient temperature as 27°C. (04 Marks)

OR

- 8 a. Set up one-dimensional time-independent Schrodinger wave equation. (10 Marks)
 b. What are the conditions for laser production? Describe briefly the applications of laser in Data storage. (06 Marks)
 c. Calculate the momentum of an electron and the de-Broglie wavelength associated with it, if its kinetic energy is 1.5 keV. (04 Marks)

Module-5

- 9 a. Give an expression for concentration of electrons and holes in an intrinsic semiconductor. Obtain the relation between Fermi energy and Energy gap of an intrinsic semiconductor. (10 Marks)
 b. Describe in brief the various types of polarization. (06 Marks)
 c. Find the polarization produced in a dielectric medium of relative permittivity 15 in presence of an electric field at 500 V/m. (04 Marks)

OR

- 10 a. Define the following : Fermi energy, Fermi velocity, Fermi temperature and Intrinsic and Extrinsic semiconductor with examples. (10 Marks)
 b. Explain any two major failures of classical free electron theory. Describe how quantum free electron theory has been successful in overcoming the failures of classical free electron theory. (06 Marks)
 c. For a metal having 6.5×10^{28} free electrons per unit volume, the relaxation time at room temperature 300 K is 3.82×10^{-14} second. Calculate its electrical conductivity using classical free electron theory. (04 Marks)
