CBCS SCHEME

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18PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2024/Jan.2025
Engineering Physics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define forced oscillation. Obtain the amplitude and phase of the forced oscillation by deriving the equation of motion. **(10 Marks)**

b. Define the following terms :
i) Subsonic wave
ii) Supersonic wave
iii) Mach number
iv) Control volume
v) Mach angle
vi) Ultrasonic wave. **(06 Marks)**

c. A 20 gram oscillator with natural frequency 10 rad/sec is vibrating in damping medium. If the damping co-efficient is 0.17, how does the oscillations decay. **(04 Marks)**

OR

2 a. Define damped oscillations. Derive the differential equation of motion for damped oscillation and obtain the value of 'α' in its general solution. **(08 Marks)**

b. Define force constant and mention its physical significance. Derive equivalent force constant for two springs in series and parallel combination. **(08 Marks)**

c. The distance between the two pressure sensors in a shock tube is 150 mm. The time taken by a shock wave to travel this distance is 0.3 m/s. Find the Mach number of the shock wave. (Given velocity of sound = 340 m/s). **(04 Marks)**

Module-2

3 a. Define cantilever and derive an expression for the depression caused in a circular cross sectional cantilever due to the suspended load. **(10 Marks)**

b. Explain the nature of elastic material with the help of stress-strain graph. **(06 Marks)**

c. Calculate the force required to produce an extension of 1 mm in steel wire of length 2 m and diameter 1 mm whose Yong's modulus $Y = 8 \times 10^{10}$ N/m^2. **(04 Marks)**

OR

4 a. Define Young's modulus(Y) and Bulk modulus(K). Derive the Relation between Y, K and σ. **(10 Marks)**

b. Explain in detail any three factors affecting the elasticity of the material. **(06 Marks)**

c. Calculate the angular twist of a wire of length 0.3m and radius 0.2 mm when a torque of 5×10^{-4} N-m is applied. Given the rigidity modulus of the material as 8×10^{10}N/m^2. **(04 Marks)**

Module-3

5 a. Derive an expression for numerical aperture and give condition for Ray Propagation in optical fiber. **(08 Marks)**

b. List out the Maxwell's equations in static and time varying field. **(08 Marks)**

c. A coil of mean radius 8 cm having 100 turns carries current of 10A, calculate the magnetic field at the centre of the coil. Given $\mu_0 = 4\pi \times 10^{-7}$ H/m. **(04 Marks)**

OR

6 a. Define current density. Derive equation of continuity. **(08 Marks)**

b. Define attenuation in optical fibers. Mention expression for attenuation coefficient. Discuss any three losses in optical fiber communication. **(08 Marks)**

c. Calculate V number for a fiber of core diameter 40 μm and with refractive indices of 1.55 and 1.50 respectively for core and cladding. The wavelength of propagating wave is 1400 nm. Assume that the fiber is in air. **(04 Marks)**

Module-4

7 a. State and explain Heisenberg uncertainty principle. Show that the electron emitted during β-decay does not pre exist inside the nucleus using uncertainty principle. **(07 Marks)**

b. Mention the three different vibrational modes of CO_2 molecule. With a neat energy level diagram explain the construction and working of CO_2 Laser. **(09 Marks)**

c. The ratio of population of two energy levels out of which one corresponds to metastable state is 1.059×10^{-30}. Find the wavelength of light emitted at 330K. Given : $K = 1.38 \times 10^{-23}$ J/K, $c = 3 \times 10^{8}$ m/s, $h = 6.63 \times 10^{-34}$ J-S. **(04 Marks)**

OR

8 a. Staring from Schrodinger's time independent wave equation obtain the expression fro Eigen energy value and Eigen function for an electron present in one dimensional potential well of infinite depth. **(07 Marks)**

b. Explain Metastable state and population inversion. Derive an expression for energy density interms of Einstein's coefficient. **(09 Marks)**

c. An electron is bound in one dimensional potential well of width 0.12 nm. Find the energy values in ground state and first excited state. Given : $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34}$ J-S. **(04 Marks)**

Module-5

9 a. Give assumption of quantum free electron theory. Derive an expression for Fermi energy at T = 0 K interms of electron concentration. **(10 Marks)**

b. What is hall effect? Arrive at the equation for Hall coefficient interms of Hall voltage. **(06 Marks)**

c. An elemental solid dielectric material has polarizability 7×10^{-40} F-m^2. Assuming the internal field to be lorentzs field, calculate the dielectric constant for the material, if it has 3×10^{28} atoms/m^3. Given $E_0 = 8.85 \times 10^{-12}$ F/m. **(04 Marks)**

OR

10 a. Define Fermi factor and Fermi energy. Explain the variation of Fermi Factor with temperature and energy of states. **(10 Marks)**

b. Define internal field in case of solid dielectrics. Derive Clausius – Morsotti equation. **(06 Marks)**

c. The charge carrier density of intrinsic germanium is 2.372×10^{19}/m^3. Assuming electron and hole motilities are 3.38m^2/v-s and 0.18m^2/V-s respectively. Calculate the resistivity of intrinsic germanium at 27°C. Given $e = 1.6 \times 10^{-19}$C. **(04 Marks)**

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