CBCS SCHEME

USN | | | | | | | | | | |

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 : $C = 3\times10^8$ m/s, $h = 6.63\times10^{-34}$ Js, $g = 9.8$ m/s^2, $e = 1.6\times10^{-19}$C, $N_A = 6.02\times10^{26}$/K mole, $k = 1.38\times10^{-23}$ 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, $Y = 2.1\times10^{11}$ N/m^2. **(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)**

* * * * *