

First/Second Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 $C = 3 \times 10^8 \text{ m/s}$; Planck's constant $h = 6.63 \times 10^{-34} \text{ J-S}$; Mass of an electron $m = 9.11 \times 10^{-31} \text{ kg}$ Boltzmann constant $K = 1.38 \times 10^{-23} \text{ J/K}$; Avagadro number $N_A = 6.02 \times 10^{26}/\text{K mole}$.

Module-1

- 1 a. Give the theory of forced vibrations and obtain the expression for amplitude. (08 Marks)
 b. With a neat diagram, explain the construction and working of Reddy tube. Mention four applications of shock waves. (08 Marks)
 c. Calculate the resonant frequency for a simple pendulum of length 1m. (04 Marks)

OR

- 2 a. Define force constant and mention its physical significance. Derive the expression for force constant for springs in series and parallel combination. (08 Marks)
 b. Define simple harmonic motion. Derive the differential equation of motion for it using Hook's law. Mention the characteristics and examples of simple harmonic motion. (08 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 0.3ms. If the velocity of sound under the same condition is 340m/s. Find the Mach number of the shock wave. (04 Marks)

Module-2

- 3 a. Explain longitudinal stress, longitudinal strain, volume stress and volume strain. Discuss the effect of stress, temperature, annealing and impurities on elasticity. (08 Marks)
 b. Derive the relation between bulk modulus(k), Young's modulus (Y) and Poisson's ratio (σ), what are the limiting values of Poisson's ratio? (08 Marks)
 c. 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 Newton applied along its 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. Describe a single cantilever and derive the expression for Young's modulus of the material of rectangular beam. (08 Marks)
 b. Derive an expression for couple per unit twist for a solid cylinder with a diagram. (08 Marks)
 c. Calculate the angular twist of a wire of length 0.3m and radius $0.2 \times 10^{-3} \text{ m}$ when a torque of $5 \times 10^{-4} \text{ Nm}$ is applied. (Rigidity modulus of the material is $8 \times 10^{10} \text{ N/m}^2$). (04 Marks)

Module-3

- 5 a. Explain Divergence and curl. Derive Gauss Divergence theorem. (08 Marks)
 b. Define V-number and fractional index change. With a neat diagrams, explain different types of optical fibers. (08 Marks)
 c. Find the divergence of the vector field \vec{A} given by $\vec{A} = 6x^2 \hat{a}_x + 3xy^2 \hat{a}_y + xyz^3 \hat{a}_z$ at a point P(1, 3, 6). (04 Marks)

OR

- 6 a. Derive the expression for displacement current. Mention 4 Maxwell's equations in differential form for time varying fields. (08 Marks)
- b. Derive an expression for numerical aperture in an optical fiber and state the condition for propagation. (08 Marks)
- c. Find the attenuation in an optical fiber of length 500m When a light signal of power 100mw emerges out of the fiber with a power 90mw. (04 Marks)

Module-4

- 7 a. State and explain Heisenberg's Uncertainty Principle. Show that the electron cannot exist inside the nucleus. (08 Marks)
- b. Define spontaneous emission and stimulated emission. Explain the construction and working of semiconductor Laser. (08 Marks)
- c. A particle of mass $0.5\text{mev}/C^2$ has kinetic energy 100eV. Find its de Broglie wavelength, where C is the velocity of light. (04 Marks)

OR

- 8 a. Assuming the time independent Schrödinger wave equation, discuss the solution for a particle in one dimensional potential well of infinite height. Hence obtain the normalized wave function. (08 Marks)
- b. Derive the expression for energy density in terms of Einstein's co-efficient. (08 Marks)
- c. The ratio of population of two energy levels is 1.059×10^{-30} . Find the wavelength of light emitted by spontaneous emissions at 330K. (04 Marks)

Module-5

- 9 a. Give the assumptions of quantum free electron theory. Discuss two success of quantum free electron theory. (08 Marks)
- b. What are polar and non-polar dielectrics? Explain types of polarization. (08 Marks)
- c. Calculate the probability of an electron occupying an energy level 0.02eV above the Fermi level at 200K and 400K in a material. (04 Marks)

OR

- 10 a. Define internal field. Mention the expressions for internal field, for one dimension, for three dimensional, and Lorentz field for dielectrics. Derive Clausius – Morsotti equation. (08 Marks)
- b. Describe Fermi level in an intrinsic semi conductor and hence obtain the expression for Fermi energy in terms of energy gap of intrinsic semiconductor. (08 Marks)
- c. An elemental solid dielectric material has polarizability $7 \times 10^{-40}\text{Fm}^2$. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has 3×10^{28} atoms/m³. (04 Marks)