

# CBCS SCHEME



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18PHY12/22

## 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  $C = 3 \times 10^8$  m/s; Planck's constant  $h = 6.63 \times 10^{-34}$  J-S ; Mass of an electron  $m = 9.11 \times 10^{-31}$  kg Boltzmann constant  $K = 1.38 \times 10^{-23}$  J/K ; Avagadro number  $N_A = 6.02 \times 10^{26}$  /K mole.

### Module-1

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

  - Define force constant and mention its physical significance. Derive the expression for force constant for springs in series and parallel combination. (08 Marks)
  - 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)
  - 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

- Explain longitudinal stress, longitudinal strain, volume stress and volume strain. Discuss the effect of stress, temperature, annealing and impurities on elasticity. (08 Marks)
  - Derive the relation between bulk modulus(k), Young's modulus (Y) and Poisson's ratio ( $\sigma$ ), what are the limiting values of Poisson's ratio? (08 Marks)
  - Calculate the extension produced in a wire of length 2m and radius  $0.013 \times 10^{-2}$  m due to a force of 14.7 Newton applied along its length. Given, Young's modulus of the material of the wire  $Y = 2.1 \times 10^{11}$  N/m<sup>2</sup>. (04 Marks)

OR

- Describe a single cantilever and derive the expression for Young's modulus of the material of rectangular beam. (08 Marks)
  - Derive an expression for couple per unit twist for a solid cylinder with a diagram. (08 Marks)
  - Calculate the angular twist of a wire of length 0.3m and radius  $0.2 \times 10^{-3}$  m when a torque of  $5 \times 10^{-4}$  Nm is applied. (Rigidity modulus of the martial is  $8 \times 10^{10}$  N/m<sup>2</sup>). (04 Marks)

### Module-3

- Explain Divergence and curl. Derive Gauss Divergence theorem. (08 Marks)
  - Define V-number and fractional index change. With a neat diagrams, explain different types of optical fibers. (08 Marks)
  - 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)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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 a semiconductor Laser. (08 Marks)
- c. A particle of mass  $0.5m_e$  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 coefficient. (08 Marks)
- c. The ratio of population of two energy levels is  $1.059 \times 10^{-30}$ . 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 successes 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 - Mossotti equation. (08 Marks)
- b. Describe Fermi level in an intrinsic semiconductor 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  $3 \times 10^{28}$  atoms/m<sup>3</sup>. (04 Marks)

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