

# CBCS SCHEME

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18PHY12/22

## First/Second Semester B.E. Degree Examination, Jan./Feb. 2021 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  $h = 6.63 \times 10^{-34} \text{ JS}$ ;  $C = 3 \times 10^8 \text{ ms}^{-1}$ ;  $\epsilon_0 = 8.854 \times 10^{-12} \text{ F m}^{-1}$ .

$K = 1.38 \times 10^{-23} \text{ J/K}$ ;  $N_A = 6.02 \times 10^{26} \text{ /K mole}$ ;  $m_e = 9.1 \times 10^{-31} \text{ kg}$ ;  $e = 1.6 \times 10^{-19} \text{ C}$ ;

$g = 9.81 \text{ m/s}$ ;  $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$ .

### Module-1

- Derive an expression for equivalent force constant for two springs in series. What is the expression for period of its oscillation? (08 Marks)
  - Distinguish between ultrasonic, subsonic, supersonic and hypersonic waves. Define Mach number and Mach Angle. (08 Marks)
  - Evaluate the natural frequency of a spring of force constant 1974 N/m, carrying a mass of 2kg. (04 Marks)

OR

- What are damped oscillations? Give the theory of damped vibrations and find the condition for critical damping. (10 Marks)
  - Describe the construction and working of Reddy's shock tube with the help of a neat sketch. (06 Marks)
  - A vibrating system of natural frequency 500Hz is forced to vibrate with a periodic force per unit mass of amplitude  $100 \times 10^{-5} \text{ N/kg}$  in the presence of a damping/unit mass of  $0.01 \times 10^{-3} \text{ rad/s}$ . Calculate the maximum amplitude of vibration of the system. (04 Marks)

### Module-2

- Define different moduli of elasticity. Derive an expression for couple per unit twist of a solid cylinder fixed at one end and the couple being applied at the other end. (10 Marks)
  - Show that for an elastic body, shear strain is equal to the sum of longitudinal strain and compressional strain. (06 Marks)
  - In a stretching experiment, the extension produced in a wire for a load of 1.5kg is  $0.2 \times 10^{-2} \text{ m}$ . The length of the wire is 2m and its radius is  $0.013 \times 10^{-2} \text{ m}$ . Find the Young's modulus of the material of the wire. (04 Marks)

OR

- Derive an expression for the Young's modulus of the material of a single cantilever in terms of depression at the free end. (08 Marks)
  - Show the relationship between Bulk modulus (K), Young's modulus (Y) and Poisson's Ratio ( $\sigma$ ). (08 Marks)
  - 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

- Describe the vector operator  $\nabla$  and explain the concepts of divergence and curl with physical significance. (08 Marks)
  - Explain the attenuation in an optical fibre? Discuss any three factors contributing to the fibre loss. (08 Marks)

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.

- c. Calculate the number of modes that can propagate inside an optical fibre with the data given below :

Refractive index of core	=	1.53
Refractive index cladding	=	1.50
Core radius	=	50 $\mu\text{m}$
Wavelength of light propagating through the optical fiber	=	1 $\mu\text{m}$

(04 Marks)

OR

- 6 a. With the help of a block diagram, explain the basics of point – to – point communication system using optical fibre. Mention any two advantages of optical communication system. (08 Marks)
- b. State and obtain Faraday's law of electromagnetic induction in differential form. (08 Marks)
- c. Find the divergence of the vector field  $\vec{A}$  given by  $\vec{A} = 3x^2 \hat{a}_x + \frac{1}{2}y^2z \hat{a}_y + 3xy \hat{a}_z$ . (04 Marks)

**Module-4**

- 7 a. Set up Schrödinger's Time independent wave equation in one dimension. (08 Marks)
- b. Explain the construction and working of semiconductor laser with the help of necessary neat diagram. (08 Marks)
- c. The inherent uncertainty in the measurement of time spent by a nuclei in the excited state is  $1.4 \times 10^{-10}$  s. Calculate the uncertainty that results in its energy in the excited state. (04 Marks)

OR

- 8 a. Show that electron cannot exist inside the nucleus of an atom. (08 Marks)
- b. Derive an expression for energy density at thermal equilibrium in terms of Eienstein's co-efficient (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 emission at 330K. (04 Marks)

**Module-5**

- 9 a. Derive an expression for electrical conductivity of an intrinsic semiconductor. (08 Marks)
- b. Define internal field and obtain the Clausius – Mossotti equation and different polarization mechanisms. (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 Fermi energy and Fermi factor. Explain the dependence of Fermi factor on temperature and energy. (08 Marks)
- b. Derive an expression for Hall coefficient and Hall voltage. (08 Marks)
- c. Find the polarization produced in a dielectric medium of relative permittivity 15 in presence of an electric field of strength 500V/m. (04 Marks)

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