CBCS SCHEME

**18PHY12/22**

USN

**First/Second Semester B.E. Degree Examination, July/August 2022**
## 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 × 10⁸ m/s, h = 6.625 × 10⁻³⁴ JS, K =1.38 × 10⁻²³ J/K,*
$N_A = 6.02 \times 10^{26}$/kmole, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$C.

**Module-1**

1 a. What are shock waves? Mention the characteristics of shock waves. **(06 Marks)**
 b. Discuss theory of forced vibrations and hence obtain the expression for amplitude. **(10 Marks)**
 c. A free particle is executing S.H.M in a straight line with a period of 25 sec, 5 sec after it has crossed the equilibrium point, the velocity is found to be 0.7 m/s. Find the displacement at the end of 10 sec, and also the amplitude of oscillation. **(04 Marks)**

**OR**

2 a. Derive the expression for equivalent force constant for 2 springs in series. What is an expression for period of its oscillation? **(06 Marks)**
 b. Explain the construction and working of Reddy tube with a neat diagram. Mention any four applications of shock waves. **(10 Marks)**
 c. A 20 gm oscillator with natural angular frequency 10 rad/sec is vibrating in damping medium. The damping force is proportional to the velocity of the vibrator. If the damping coefficient is 0.17, how does the oscillation decay? **(04 Marks)**

**Module-2**

3 a. State and explain Hooke's law with the help of stress-strain diagram. Define elastic limit. **(06 Marks)**
 b. Define bending moment. Derive an expression for Young's modulus of single cantilever beam. **(09 Marks)**
 c. An increment in length by 1 mm was observed in a gold wire of diameter 0.3 mm, when it was subjected to a longitudinal force of 2 Newtons and a twist of 0.1 radian was observed in the same wire when its one end was subjected to a torque of 7.9 × 10⁻⁷ Nm, while its other end was fixed. Calculate the value of Poisson's ratio of gold. **(05 Marks)**

**OR**

4 a. Derive the relation between K, Y and σ where the symbols have their usual meaning. **(07 Marks)**
 b. Derive the expression for couple per unit twist of a solid cylinder. **(10 Marks)**
 c. Calculate the Poisson's ratio for silver given Young's modulus is 7.25 × 10¹⁰ N/m² and bulk modulus is 11 × 10¹⁰ N/m². **(03 Marks)**

**Module-3**

5 a. Describe the concept of divergence. What is the physical significance? Derive Gauss divergence theorem. **(09 Marks)**
 b. With neat diagrams, explain different types of optical fibers. **(07 Marks)**
 c. Find the divergence of the vector field $\vec{A}$ given $\vec{A} = 6x^2\hat{a}_x + 3xy^2\hat{a}_y + xyz^3\hat{a}_z$ at a point P(1, 3, 6) **(04 Marks)**

**OR**

6  a. What is displacement current? Derive an expression for displacement current.  (06 Marks)
   b. Explain the terms:
      (i)   Total internal reflection
      (ii)  Acceptance angle
      (iii) Numerical aperture.
      Obtain an expression for numerical aperture.  (09 Marks)
   c. The attenuation in an optical fiber is 3.6 dB/km. What fraction of its initial intensity remains after (i) 1 km   (ii) 2 km   (iii) 3 km?  (05 Marks)

## Module-4

7  a. Setup one dimensional time independent Schrodinger wave equation.  (08 Marks)
   b. Derive an expression for energy density using Eeinstein's coefficients.  (08 Marks)
   c. A spectral line of wavelength $5461 \overset{\circ}{A}$ has a width of $10^{-4} \overset{\circ}{A}$. Evaluate the minimum time spent by the electrons in the upper energy state.  (04 Marks)

**OR**

8  a. With a proper energy level diagram, explain the construction and working of semiconductor laser. Write a short note on laser range finder.  (10 Marks)
   b. Explain the four properties of wave function.  (06 Marks)
   c. The ratio of population of two energy levels is $1.059 \times 10^{-30}$. Find the wavelength of light emitted by laser at 330 K.  (04 Marks)

## Module-5

9  a. Give the assumptions of quantum free electron theory and hence obtain an expression for the Fermi energy of 0 K.  (10 Marks)
   b. What are dielectrics? Derive Clausius-Mossotti equation.  (06 Marks)
   c. The conductivity and Hall coefficient of an n-type semiconductor are $112/\Omega$m and $1.25 \times 10^{-3}$ m$^3$/c respectively. Calculate the charge carrier concentration and electron mobility.  (04 Marks)

**OR**

10 a. Describe Fermi level in intrinsic semiconductor and hence obtain an expression for Fermi energy interms of energy gap of intrinsic semiconductor.  (08 Marks)
   b. What is Hall effect? Obtain an expression for charge density and Hall voltage interms of Hall coefficient.  (08 Marks)
   c. An elemental solid dielectric material has polarizability $7 \times 10^{-40}$ 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$^3$.  (04 Marks)

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