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18PHY12

**First Semester B.E. Degree Examination, Dec.2018/Jan.2019**

## 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,  $h = 6.63 \times 10^{-34}$  JS*
  - Mass of electron,  $m_e = 9.1 \times 10^{-31}$  kg*
  - Charge of electron,  $e = 1.6 \times 10^{-19}$  C*
  - Boltzmann constant =  $1.38 \times 10^{-23}$  JK<sup>-1</sup>*
  - Avagadro number =  $6.02 \times 10^{23}$  /mol.*

### Module-1

- 1 a. What are shock waves? Mention the characteristics and applications of shock waves. (06 Marks)
- b. What are damped oscillations? Give the theory of damped oscillations and hence discuss the case of critical damping. (10 Marks)
- c. A free particle is executing simple harmonic motion in a straight line with a period of 25 seconds; 5 seconds 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 seconds and also amplitude of oscillations. (04 Marks)

OR

- 2 a. Define SHM. Mention the characteristics of SHM. Give one example of SHM. (06 Marks)
- b. With a neat diagram, explain the construction and working of Reddy's shock tube. Mention conservation of mass energy and momentum expressions. (10 Marks)
- c. A mass of 0.5kg causes an extension of 0.03m in a spring and the system is set for oscillations. Find i) The force constant for the spring ii) Angular frequency and iii) Time period of the resulting oscillation. (04 Marks)

### Module-2

- 3 a. State and explain Hooke's law. Define elastic and plastic limits. (06 Marks)
- b. Define Young's modulus of materials. Derive an expression for the Young's modulus of a beam using single cantilever method. (10 Marks)
- c. Calculate the torque required to twist a wire of length 1.5m, radius  $0.0425 \times 10^{-2}$ m through an angle of  $(\pi/45)$  radians, if the value of rigidity modulus of the material is  $8.3 \times 10^{10}$  N/m<sup>2</sup>. (04 Marks)

OR

- 4 a. What is Bending moment? Mention various types of beams and their engineering applications (any four). (06 Marks)
- b. What are the types of Elastic moduli? Derive a relation between Y, K and  $\sigma$ . (10 Marks)
- c. Calculate the Force required to produce an extension of 1mm in steel wire of length 2m and diameter 1mm. ( $Y = 2 \times 10^{11}$  N/m<sup>2</sup>) (04 Marks)

Important Note : 1. On completing your answer, 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.

**Module-3**

- 5 a. What is Numerical Aperture? Derive an expression for the same. (06 Marks)  
 b. State and explain Maxwell's equation for electromagnetic field. Starting from Maxwell's equations, deduce the wave equation for a plane wave in free space. (10 Marks)  
 c. Determine constant C, such that  $\vec{A} = (x + ay)\hat{a}_x + (y + bz)\hat{a}_y + (x + cz)\hat{a}_z$  is solenoidal. (04 Marks)

OR

- 6 a. Explain the types of fiber losses. (06 Marks)  
 b. State and explain Gauss Divergence theorem. Mention the Stoke's theorem. (10 Marks)  
 c. The refractive indices of core and clad are 1.50 and 1.48 respectively in an optical fiber. Find the numerical aperture and angle of acceptance. (04 Marks)

**Module-4**

- 7 a. Setup one dimensional time independent Schrödinger wave equation. (06 Marks)  
 b. Mention the three modes of vibration in CO<sub>2</sub> molecule. With neat diagrams explain the construction and working of CO<sub>2</sub> laser. (10 Marks)  
 c. A pulsed laser emits photons of wavelength 780nm with 20mW average power/pulse. Calculate the number of photons contained in each pulse if the pulse duration is 10ns. (04 Marks)

OR

- 8 a. Prove that electron cannot exist inside the Nucleus of an atom. (06 Marks)  
 b. Derive an expression for energy density in terms of Einstein's coefficients. (10 Marks)  
 c. An electron is bound in a one dimensional potential well of width 1Å, but infinite wall height. Find its energy values in the ground state and in the first two excited states. (04 Marks)

**Module-5**

- 9 a. What are the assumptions of Quantum Free Electron Theory (QFET)? Explain the merits of QFET. (06 Marks)  
 b. What is Hall Effect? Derive an expression for Hall voltage in terms of Hall coefficient. (10 Marks)  
 c. Find the temperature of which there is 1% probability that a state with an energy 0.5eV above the Fermi energy is occupied. (04 Marks)

OR

- 10 a. What is polarization? Explain various types of polarizations mechanisms. (06 Marks)  
 b. What is Fermi Energy? Derive an expression for Fermi Energy at zero Kelvin for a metal. (10 Marks)  
 c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-m. Assuming the electron and hole mobilities as 0.38 and 0.18 m<sup>2</sup>/V-Sec respectively. Calculate the intrinsic carrier density. (04 Marks)

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