

# CBCS Scheme

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15PHY12/22

## First/Second Semester B.E. Degree Examination, June/July 2017 Engineering Physics

Time: 3 hrs.

Max. Marks: 80

*Note: 1. Answer FIVE full questions, choosing one full question from each module.*

*2. Physical constants : Velocity of light,  $c = 3 \times 10^8$  m/s;  $h = 6.625 \times 10^{-34}$  J-S;*

*$k = 1.38 \times 10^{-23}$  J/K;  $N_A = 6.02 \times 10^{23}$ /Kmole;  $m_e = 9.1 \times 10^{-31}$  kg;  $e = 1.6 \times 10^{-19}$  C.*

### Module-1

- 1 a. Define phase velocity and group velocity. Derive an expression for group velocity in terms of phase velocity. (05 Marks)
- b. What is wave function? Set up time-independent Schrodinger's wave equation in one dimension. (07 Marks)
- c. A spectral line of wavelength 5896 Å has a width of  $10^{-5}$  Å. Evaluate the minimum time spent by the electrons in the upper energy state between the excitation and de-excitation processes. (04 Marks)

OR

- 2 a. What is a blackbody? Explain energy spectrum of a Blackbody. (05 Marks)
- b. Obtain energy values and normalized wave function, with respect to a particle in an one dimensional potential well of infinite height. (07 Marks)
- c. Compare the energy of a photon with that of a neutron when both are associated with a wavelength 0.25 nm, mass of neutron is  $1.675 \times 10^{-27}$  kg. (04 Marks)

### Module-2

- 3 a. State law of mass action and derive the expression for electrical conductivity of a semiconductor. (05 Marks)
- b. Write a note on high temperature superconductors and Maglev vehicles. (07 Marks)
- c. Gold has one free electron/atom. Its density, atomic weight and resistivity are 19300 kg/m<sup>3</sup>, 197 and  $2.21 \times 10^{-8}$  Ωm. Calculate the free electron concentration and mobility of conduction electron. (04 Marks)

OR

- 4 a. What is Fermi factor? Discuss the variation of Fermi factor with temperature. (05 Marks)
- b. What are the assumptions of quantum free electron theory? Derive the expression for electrical conductivity based on quantum free electron theory. (07 Marks)
- c. Calculate the drift velocity and thermal velocity of conduction electrons in copper at a temperature of 300 K, when a copper wire of length 2 m and resistance 0.02 Ω carries a current of 15 A. Given the mobility of free electrons in copper is  $4.3 \times 10^{-3}$  m<sup>2</sup>/V.S. (04 Marks)

### Module-3

- 5 a. Explain the construction and working of a semi-conductor laser. (06 Marks)
- b. Explain three different types of optical fibers with neat diagrams. (06 Marks)
- c. A pulsed laser emits photons of wavelength 820 nm with 22 mW average power/pulse. Calculate the number of photons contained in each pulse, if the pulse duration is 12 ns. (04 Marks)

OR

- 6 a. Derive the expression for energy density of radiation in terms of Einstein's coefficients. (06 Marks)
- b. What is attenuation? Explain factors contributing to the fiber losses. (06 Marks)
- c. A glass clad fiber is made with core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.0005. Determine the cladding index and numerical aperture. (04 Marks)

Module-4

- 7 a. Derive the expression for interplanar spacing in terms of Miller Indices. (05 Marks)
- b. Describe how Bragg's spectrometer is used to determine the crystal structure. (07 Marks)
- c. Draw the following planes in a cubic unit cell.  
i) (001)      ii) (110)      iii) (112)      iv) (020). (04 Marks)

OR

- 8 a. Define Allotropy and polymorphism with examples. (05 Marks)
- b. What are lattice parameters? Explain seven crystal systems. (07 Marks)
- c. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b and parallel to z-axis and also calculate the interplanar distance of the planes taking the lattice to be cubic with  $a = b = c = 2\text{\AA}$ . (04 Marks)

Module-5

- 9 a. What is Mach number? Explain experimental method of finding Mach number of a shock wave by Reddy Shock tube. (06 Marks)
- b. Describe arc discharge method of obtaining carbon nano tubes with the help of a diagram. (06 Marks)
- c. Distinguish between acoustic, ultrasonic, subsonic and supersonic waves. (04 Marks)

OR

- 10 a. Discuss the basis of laws of conservation of energy, mass and momentum. (07 Marks)
- b. Discuss the structure and properties of carbon nano tubes. (05 Marks)
- c. Explain Sol-gel method of preparing nanomaterials. (04 Marks)

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