

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 a 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 1.675×10^{-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/m³, 197 and 2.21×10^{-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 4.3×10^{-3} m²/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) ($\bar{1}\bar{1}$ 0) iii) (1 1 2) iv) (0 2 0). (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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