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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

First Semester, B.E. - Semester End Examination; Dec - 2016/Jan - 2017

Engineering Physics
(Common to all Branches)

Time: 3 hrs

Max. Marks: 100

Note: Answer FIVE full questions, selecting ONE full question from each unit.

Physical Constants: Electron mass = 9.11×10^{-31} kg, Planck's constant = 6.63×10^{-34} Js, Electron Charge = 1.602×10^{-19} C, Boltzmann Constant = 1.38×10^{-23} J/K, Avogadro number = 6.025×10^{26} /K mole, Permittivity of free space = 8.854×10^{-12} F/m, Velocity of light = 3×10^8 m/s.

UNIT - I

- 1 a. Define the terms 'Stream line flow' and Turbulent flow. Derive Euler's equation of motion along a stream line. 8
- b. Write a note on mechanical energy and efficiency of fluids. 7
- c. The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur. Given; 5
Density of sulphur = 2.07 gm/cc and atomic weight = 32.07.
- 2 a. What is internal field? Derive an expression for internal field in the case of solids. 8
- b. Define dielectric polarization. Explain briefly electronic polarization and orientation polarization. 7
- c. State Bernoulli's theorem. Mention its limitations. 5

UNIT - II

- 3 a. Define group velocity. Derive an expression for deBroglie wavelength using the concept of group velocity. 8
- b. State and explain Wein's law, Rayleigh-Jeans law and Planck's law of reduction. 7
- c. In a measurement that involved a maximum uncertainty of 0.003%, the speed of an electron was found to be 800 m/s. Calculate the corresponding uncertainty involved in determining its position. 5
- 4 a. Assuming the time independent Schrodinger wave equation, discuss the solution for a particle in one dimensional potential well of infinite height. Hence obtain the normalized wave function. 8
- b. State and explain Heisenberg uncertainty principle. Show that the electron does not exist inside the nucleus of an atom by uncertainty principle. 7

- c. A fast moving neutron is found to have an associated deBroglie wavelength of 2×10^{-12} m. Find its kinetic energy and group velocity of the deBroglie waves using the relativistic change in mass. Mass of Neutron = 1.675×10^{-27} kg. 5

UNIT - III

- 5 a. Define density of states. Derive an expression for the density of states for conduction electrons for unit volume of metal. 8
- b. What are the conduction electrons? Explain the failures of classical free electron theory. 7
- c. What are intrinsic and extrinsic semiconductors? The intrinsic carrier density at room temperature in Ge is $2.37 \times 10^{19}/\text{m}^3$. If the electron and hole mobility are $0.38 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$ and $0.18 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$ respectively. Calculate the resistivity. 5
6. a. Derive an expression for the electron concentration in an intrinsic semiconductor. 8
- b. Write a note on the significance of Fermi level in n-type and p-type semiconductors. 7
- c. Show that occupation probability at $E = E_F + \Delta E$ is equal to non-occupation probability at $E = E_F - \Delta E$. 5

UNIT - IV

- 7 a. Explain the variation of density of states for different quantum structures. 8
- b. With a neat diagram, explain the construction and working of scanning tunneling microscope. 7
- c. What is superconductivity? Write a note on BCS theory. 5
- 8 a. Write short note on: 8
- i) Superconducting magnet ii) Maglev vehicle.
- b. Discuss Type-I and Type-II superconductors. 7
- c. What are carbon nanotubes? Mention any two properties and two applications of nanotubes. 5

UNIT - V

- 9 a. Describe the construction and working of a semiconductor laser diode. 5
- b. Explain the experimental method of determining the velocity of ultrasonics in liquids. 5
- c. Explain the acoustic requirements of a good auditorium. 5
- d. Describe the basics of point-point communication system using optical fibres. 5
- 10 a. With neat diagrams explain the step-index multimode and graded index multimode fibres. 5
- b. Explain how flaw in a solid can be detected using ultrasonics. 5
- c. Derive the relations between Einstein's coefficients. 5
- d. Explain the various factors that affect architectural acoustics. 5