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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

Contd…2

c. A fast moving neutron is found to have an associated deBroglie wavelength of $2x10^{-12}$ 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 $2.37x10^{19}/m^3$. If the electron and hole mobility are 0.38 $m^2V^{-1}s^{-1}$ and 0.18 $m^2V^{-1}s^{-1}$ 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

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