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

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, B.E. - Semester End Examination; June - 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.*

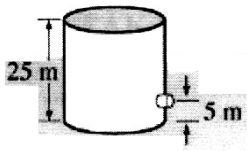
***Physical Constants:** Electron mass = 9.11×10^{-31}kg, Planck's constant = 6.63×10^{-34}Js, Electron Charge = 1.602×10^{-19}C, Boltzmann Constant = 1.38×10^{-23}J/K, Avogadro number = 6.025×10^{26}/k mole, Permittivity of free space = 8.854×10^{-12}F/m, Velocity of light = 3×10^{8} m/s.*

UNIT - I

1 a. Explain mechanical energy and efficiency of the fluid. 8

b. Define internal field. Obtain an expression for it in case of one dimensional solid. 8

c. A large tank, 25 m in height and open at the top is completely filled with saltwater (density 1025 kg/m^3). A small drain plug with a cross-sectional area of 4.0×10^{-5} m^2 is located 5.0 m from the bottom of the tank. The plug breaks loose from the tank and water flows from the drain. Calculate the speed of the water as it leaves the hole in the side of the tank.



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2 a. Define Dielectric loses. Derive Clausius-Mossotti equation for a dielectric material. 8

b. State Bernoulli's theory. Explain the conservation of mass, momentum and energy. 8

c. The dielectric constant of sulphur is 3.4, assuming the internal field as Lorentz field, calculate the electronic polarizability of sulphur. Given that density of sulphur $= 2.07\times10^3$ kg/m^3 and atomic weight $= 32.07$. 4

UNIT - II

3 a. Define phase velocity and group velocity and write their equations. Establish the relation between phase velocity and group velocity. 8

b. State Heisenberg's uncertainty principle. Using this principle show that a free electron cannot exist within the nucleus of an atom. 8

c. An electron has a deBroglie wavelength of 1.66×10^{-10} m. Find its kinetic energy and group velocity of the deBroglie wave associated with it. 4

4 a. By solving Schrodinger's wave equation, obtain the normalized Eigen function for a particle in one dimensional potential well of infinite height using boundary conditions. 8

b. What are matter waves? Derive an expression for the deBroglie wavelength using the concept of group velocity. 8

Contd….2

c. An electron is trapped in one dimensional potential well of width 3 Å and infinite height. Find the amount of energy required to excite the electron from the ground state to its second excited state. 4

UNIT - III

5 a. Define density of states. Obtain an expression for density of states. 8

b. Derive an expression for the electron concentration at a given temperature in an intrinsic semiconductor. 8

c. Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K in a metal. 4

6 a. Define Fermi energy and Fermi factor. Discuss the dependence of Fermi factor with energy and temperature. 8

b. With a neat diagram, explain the Fermi level in intrinsic and extrinsic semiconductors. 8

c. Calculate the Fermi energy (in eV) for sodium, having free electron density of $2.542\times10^{28}/m^3$. 4

UNIT - IV

7 a. Explain the factors affecting the variation of physical properties from bulk to thin films and to nano materials. 8

b. Discuss in brief : i) BCS theory of superconductivity ii) Superconducting magnet. 8

c. Give a brief account of high temperature superconductivity. 4

8 a. What is superconductivity? Describe Type - I and Type - II superconductors. 8

b. With a neat diagram, explain the confinement of electron energy states in 0-D, 1-D, 2-D and 3-D systems. 8

c. Explain the working of Maglev vehicle. 4

UNIT - V

9 a. Describe the construction of semiconductor laser and explain its working with the help of energy level diagram. 5

b. Explain the non-destructive method of testing the materials using ultrasonics. 5

c. The numerical aperture of an optical fiber is 0.2 when surrounded by air. Determine the refractive index of its core given the refractive index of the cladding is 1.59. Also find the acceptance angle when the fiber in water. Assume the refractive index of water is 1.33. 5

d. Define reverberation time. Discuss Sabine's formula. 5

10 a. Define numerical aperture. Obtain an expression for numerical aperture. 5

b. Explain the basic requirements of the acoustical auditorium. 5

c. The ratio of population of two energy levels out of which upper one corresponds to meta stable state is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K. 5

d. Describe the determination of velocity of ultrasonic in liquid. 5

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