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

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, B.E. - Semester End Examination; April - 2021

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, $m = 9.11\times10^{-31}$ kg, Electron charge, $e = 1.602\times10^{-19}$ C; Velocity of light, $c = 3\times10^{8}$ ms^{-1}; Planck's constant, $h = 6.626\times10^{-34}$ Js; Boltzmann constant, $K = 1.38\times10^{-23}$ JK^{-1}; Avogadro number, $N = 6.025\times10^{23}$/mole; Permittivity of free space, $\varepsilon_o = 8.85\times10^{-12}$ Fm^{-1}.*

UNIT - I

1 a. Derive Euler's equation of motion along a stream line. 8

b. Write a note on mechanical energy and efficiency of fluids. 5

c. Derive an expression for internal field in case of solid dielectric. 7

2 a. Explain the working principle of atomizer in spraying of water into air. 7

b. Describe in brief the various types of polarization. 8

c. A parallel plate capacitor area 650 mm^2 and a plate separation of 4 mm has a charge of 2×10^{-10} C on it. What is the resultant voltage across the capacitor when a material of dielectric constant 3.5 is introduced between the plates? 5

UNIT - II

3 a. Explain the distribution of energy in blackbody radiation spectrum. Mention the limitations of Wien's and Rayleigh - Jeans law. 8

b. Derive an expression for deBroglie wavelength in from of group velocity concept. 7

c. An electron is bound in one dimensional infinite potential well of width 1Å. Find its energy values in the ground state and also in the 1st two excited states. 5

4 a. State Heisenberg's uncertainty principle and show that electron doesn't exist inside the nucleus of an atom. 8

b. Set up time independent one dimensional Schrodinger wave equation. 7

c. If an electron has a de-Broglie wavelength of 2 nm, find its kinetic energy and group velocity. Given that it has rest mass energy of 511 keV. 5

UNIT - III

5 a. Mention the successes of classical free electron theory and explain how quantum free electron theory overcomes the failures of classical free electron theory? 8

b. Discuss the variation of Fermi factor on different conditions of temperature and energy. 8

c. An electron concentration in an N-type semiconductor is 5×10^{17} m^{-3}. Calculate the conductivity of material, if the drift velocity of an electron is 350 m/s in an electric field of 1000 V/m. 4

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6 a. Define law of mass action. Deduce the relation between Fermi energy and energy gap for an intrinsic semiconductor. 8

b. Derive the expression for electrical conductivity of an intrinsic semiconductor. 7

c. Calculate the Fermi energy in eV for a metal at 0 K, whose density is 10500 kg/m^3, atomic weight 107.9 and it has 1 conduction electron per atom. Given 1 J = 6.24×10^{18} eV and $N_A = 6.025 \times 10^{26}$ / k mole. 5

UNIT - IV

7 a. Describe how BCS theory explains superconductivity? 7

b. Discuss the variation of density of states for different quantum structures. 8

c. Mention the applications of Nanomaterials. 5

8 a. Describe Type-I and Type-II superconductors. 8

b. Explain the working principle of Scanning Tunneling Microscope with the help of a neat diagram. 7

c. A superconducting tin has a critical field of 306 gauss at 0 K (H_0) and 217 gauss (H_c) at 2 K. Find the critical temperature of superconducting tin. 5

UNIT - V

9 a. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein coefficients. 5

b. Discus single mode and graded index optical fiber mode with suitable diagram. 5

c. Discus how the velocity of ultrasonics in liquids can be measured. 5

d. A volume of the hall is 475 m^3. The area of wall is 200 m^2, area of floor and ceiling each of 100 m^2. If absorption coefficients of the wall, ceiling and floor are 0.025, 0.02 and 0.55 respectively, calculate the reverberation time for the hall. 5

10 a. Discus the conditions required for laser action. 5

b. The acceptance angle of optical fiber is 30° when kept in air. Find the angle of acceptance, when it is in a medium of refractive index 1.33. 5

c. Explain with a neat diagram how a flaw in solid material is detected by non-destructive method of testing using ultrasonics? 5

d. What is reverberation time? Using Sabine's formula, explains how the reverberation time is determined? 5

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