



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

(An Autonomous Institution affiliated to VTU, Belagavi)

**Second Semester, B.E. - Semester End Examination; May/June - 2019**

### 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,  $m = 9.11 \times 10^{-31}$  kg, Electron charge,  $e = 1.602 \times 10^{-19}$  C; Velocity of light,  $c = 3 \times 10^8$  ms<sup>-1</sup>; Planck's constant,  $h = 6.626 \times 10^{-34}$  Js; Boltzmann constant,  $K = 1.38 \times 10^{-23}$  JK<sup>-1</sup>; Avogadro number,  $N = 6.025 \times 10^{23}$ /mole; Permittivity of free space,  $\epsilon_0 = 8.85 \times 10^{-12}$  Fm<sup>-1</sup>.

#### UNIT - I

- 1 a. What is equation of continuity? Derive an expression for equation of continuity for a fluid. 7
- b. Write a note on; 8
- (i) Venturimeter                      (ii) Atomizer
- c. Derive Clausius-Mossotti equation for dielectrics. 5
- 2 a. Describe in brief the various types of polarization. 8
- b. Derive Euler's equation along a streamline. 7
- c. An elemental solid dielectric material has polarizability  $7 \times 10^{-40}$  Fm<sup>2</sup>. Assuming that the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has  $3 \times 10^{28}$  atoms/m<sup>3</sup>. 5

#### UNIT - II

- 3 a. State Planck's radiation law, Wien's law, Rayleigh jeans law and Stefan-Boltzmann law. 8
- b. Define Phase velocity and Group velocity. Show that group velocity is equal to particle velocity. 7
- c. In a measurement that involved a maximum uncertainty of 0.002%, the speed of an electron was found to be 500 m/s. Calculate the corresponding uncertainty involved in determining its position. 5
- 4 a. Obtain the energy Eigen values and Eigen functions for a particle in one dimensional potential well of infinite height using Schrodinger's time independent wave equation. 8
- b. State Heisenberg's uncertainty principle and show that electron does not exist inside the nucleus by this principle. 7
- c. Find de-Broglie wavelength of a particle of mass  $0.58 \text{ MeV}/c^2$ , has a kinetic energy 90 eV, where  $c$  is the velocity of light. 5

#### UNIT - III

- 5 a. Define density of states. Obtain an expression for density of states of energy levels. 8
- b. What is Fermi energy? Write an expression for Fermi factor. Discuss the variations of Fermi factor with temperature and energy. 7
- c. Calculate the intrinsic carrier density and conductivity of germanium semiconductor at 300 K. Given that  $\mu_e = 0.37 \text{ m}^2/\text{Vs}$ ,  $\mu_h = 0.16 \text{ m}^2/\text{Vs}$  and  $E_g$  of Ge = 0.7 eV. Assuming that  $m_e = m_h = m_e$ . 5

- 6 a. Derive an expression for carrier concentration of electrons in an intrinsic semiconductor. 8
- b. Define law of mass action. Derive an expression for Fermi level in an intrinsic semiconductor. 7
- c. Find the temperature at which there is 1% probability that a state with energy 0.5 eV above Fermi energy is occupied. 5

#### UNIT - IV

- 7 a. Describe the various quantum structures with figure and density of state equations. 8
- b. Discuss type-I and type-II superconductors. 7
- c. Write a note on carbon nanotubes. 5
- 8 a. Explain BCS theory and Meissner effect. 8
- b. Explain the working of scanning tunneling microscope with the help of a neat diagram. 7
- c. A superconducting tin has a critical field of 306 gauss at  $0\text{ K}$  ( $H_0$ ) and 217 gauss ( $H_c$ ) at 2 K. Find the critical temperature of superconducting tin. 5

#### UNIT - V

- 9 a. Describe construction and working of semiconductor diode laser. 5
- b. Define angle of acceptance. Obtain an expression for numerical aperture in an optical fiber. 5
- c. What is ultrasonics? Mention its applications. 5
- d. A cinema hall has a volume of  $7500\text{ m}^3$ . It is required to have reverberation time of 1.5 sec. What should be the total absorption in the hall? 5
- 10 a. Explain laser welding, cutting and drilling process with necessary diagram. 5
- b. An optical fiber has clad of refractive index 1.50 and numerical aperture 0.39, Find the refractive index of the core and the acceptance angle. 5
- c. Explain with a neat diagram how a flaw in solid material is detected by non-destructive method using ultrasonics. 5
- d. Mention and explain the basic requirements of the good auditorium. 5

\* \* \* \*