U.S.N. | | | | | | | | | |

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E.   **Semester: I / II**
Branch: Common to all Branches   **Duration: 3 hrs.**
Course Code: 18PY1BSPHY / 18PY2BSPHY   **Max Marks: 100**
Course: APPLIED PHYSICS   **Date: 20.05.2023**

Instructions: Answer five full questions, choosing one full question from each unit

Physical constants:

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg   Speed of light, $c = 3 \times 10^8$ m/s
Electronic charge, $e = 1.602 \times 10^{-19}$ C   Planck constant, $h = 6.626 \times 10^{-34}$ Js
Boltzmann constant, $k_B = 1.38 \times 10^{-23}$ J/K   Mass of proton/neutron, $m = 1.67 \times 10^{-27}$ kg
Avogadro number, $N_A = 6.023 \times 10^{26}$/k.mol   Permittivity of free space $\varepsilon_o = 8.85 \times 10^{-12}$ F/m

UNIT-1

1	a)	Define phase velocity and group velocity. Derive the relation between them in terms of wave length.	**8**
	b)	Set up one dimensional time independent Schrodinger's wave equation. List the properties of wave function.	**8**
	c)	Find the momentum of an electron and the de Broglie wavelength associated with it if its kinetic energy is 1.5 keV.	**4**

OR

2	a)	What are matter waves? Derive the expression for de-Broglie wavelength using the concept of group velocity.	**8**
	b)	State Heisenberg's uncertainty principle. Apply the Heisenberg's uncertainty principle to show the non-existence of electron inside the nucleus.	**8**
	c)	A quantum particle confined to one dimensional box of width 'a' is in its ground state. What is the probability of finding the particle over an interval of (a/2) marked symmetrically at the center of the box?	**4**

UNIT – II

3	a)	What is Fermi energy of a metal? Assuming the expression for density of states, deduce an expression for Fermi energy in terms of electron concentration, at 0K.	**8**
	b)	With a neat labelled diagram explain the determination of thermal conductivity of a good conductor using Forbe's method.	**8**
	c)	Show that the sum of the probability of occupancy of an energy state at ΔE below Fermi level and that at ΔE above the Fermi level is unity.	**4**

UNIT- III

4 a) Derive an expression for internal field of a solid dielectric having one dimensional array of atoms. **8**

   b) Prove that the Fermi level in an intrinsic semiconductor lies mid-way between the top of the valence band and the bottom of the conduction band at 0K. Indicate the Fermi level in intrinsic and extrinsic semiconductors. **8**

   c) The dielectric constant of Helium at 0^0 C is 1.000074. The density of atoms is 2.7×10^{25} m^{-3}. Find the dipole moment induced in each atom when the gas is in an electric field of 3×10^4 V m^{-1}. **4**

UNIT – IV

5 a) What is Holography? With a neat diagram, explain the recording and reconstruction of hologram. **8**

   b) What is attenuation? Explain the causes for the attenuation. **8**

   c) The attenuation in an optical fiber is 4.8 dB km^{-1}. What fraction of its initial intensity remains after i) 2 km and ii) after 4 km? **4**

OR

6 a) With a neat labelled band diagrams, explain the construction and working of Semiconductor laser. **8**

   b) What is acceptance angle of an optical fiber? Derive the expression for Numerical aperture of an optical fiber. **8**

   c) The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted by spontaneous emission at 300K. **4**

UNIT – V

7 a) What is simple harmonic motion (SHM)? Explain the conservation of energy from kinetic to potential in SHM. **8**

   b) What is forced vibration? Set up and solve the differential equation for the forced harmonic oscillator and arrive at an expression for amplitude. **8**

   c) A 20 gm oscillator with natural angular frequency 10 rad/s is vibrating in damping medium. If the damping coefficient is 0.17 kg/s, how does the oscillator decay? **4**

******