U.S.N.										

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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary 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: 14.09.2023**

Instructions: 1. Answer **FIVE** full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Physical constants:

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	***CO***	***PO***	**Marks**
1	a)	Define group velocity. Derive an expression for group velocity on the basis of superposition of waves.		*CO1/ CO2*	*PO1*	8
	b)	Using Schrodinger wave equation derive a normalized eigen function for a particle in one dimensional potential well of infinite height by applying boundary conditions.		*CO1/ CO2*	*PO1*	8
	c)	A particle of mass 0.5 MeV/c^2 has kinetic energy 100 eV. Find its de Broglie wavelength, where c is the velocity of light.		*CO2*	*PO1*	4
		OR				
2	a)	State de-Broglie hypothesis of matter waves. Derive an expression for de-Broglie wavelength using the concept of group velocity.		*CO1/ CO2*	*PO1*	8
	b)	State Heisenberg's uncertainty principle. Prove that an electron does not exist inside the nucleus, using this principle.		*CO1/ CO2*	*PO1*	8
	c)	An electron is trapped in one dimensional potential well of width 1 Å and infinite height. Find the amount of energy required to excite the electron to its fifth excited state from ground state.		*CO2*	*PO1*	4
		UNIT - II				
3	a)	Mention the assumptions of quantum free electron theory and explain any two of its merits.		*CO1/ CO2*	*PO1*	8
	b)	State Wiedemann-Franz law. Derive an expression for thermal conductivity of a conductor using classical free electron theory.		*CO1/ CO2*	*PO1*	8

		c)	Calculate the probabilities of an electron occupying an energy level 0.02 eV above the Fermi level and that in an energy level 0.02 eV below the Fermi level at 200 K.	*CO2*	*PO1*	4
			UNIT - III			
	4	a)	Derive an expression for internal field in case of liquid or solid dielectrics.	*CO1/ CO2*	*PO1*	8
		b)	What is Hall effect? Obtain an expression for Hall voltage in terms of Hall coefficient.	*CO1/ CO2*	*PO1*	8
		c)	The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur. Given, density of sulphur: 2.07×10^3 kg/m^3, atomic weight: 32.07.	*CO2*	*PO1*	4
			UNIT - IV			
	5	a)	With neat energy level diagram, explain the construction and working of He-Ne laser.	*CO1/ CO2*	*PO1*	8
		b)	Describe the different types of optical fiber along with the typical core and cladding diameter, refractive index profile and mode propagation sketches.	*CO1/ CO2*	*PO1*	8
		c)	Fractional index change of an optical fiber and refractive index of core are 0.5 % and 1.533 respectively. Calculate the angle of acceptance.	*CO2*	*PO1*	4
			OR			
	6	a)	Derive an expression for energy density of radiation in terms of Einstein coefficients under thermal equilibrium.	*CO1/ CO2*	*PO1*	8
		b)	Define co-efficient of attenuation and write an equation for it. Explain the various attenuation mechanisms that introduce losses in optical fiber.	*CO1/ CO2*	*PO1*	8
		c)	The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K.	*CO2*	*PO1*	4
			UNIT - V			
	7	a)	Derive an expression for total energy of a harmonic oscillator and represent graphically the variation of potential, kinetic and total energy with time.	*CO1/ CO2*	*PO1*	8
		b)	What are forced oscillations? Arrive at an expression for amplitude in case of forced oscillations.	*CO1/ CO2*	*PO1*	8
		c)	An electric motor weighing 50 kg is mounted on 4 springs each of which has a spring constant 2×10^3 N/m. The motor moves only in vertical direction. Find the natural frequency and time period of the system.	*CO2*	*PO1*	4

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