U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2024 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

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
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 neutron, $m_n = 1.67 \times 10^{-27}$ kg
Permittivity of free space$= 8.85 \times 10^{-12}$ F/m
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)		State and explain the de-Broglie hypothesis. Obtain an expression of de-Broglie wavelength from group velocity.	*CO1/ CO2*	*PO1*	**8**
	b)		State Heisenberg's Uncertainty principle. Using this principle show that a free electron cannot exist within the nucleus of an atom.	*CO1/ CO2*	*PO1*	**8**
	c)		Calculate the first three energies of a proton in the ground state confined in a potential well of width 0.5×10^{-10} m.	*CO2*	*PO1*	**4**
			OR			
2	a)		Set up an one-dimensional time-independent Schrodinger's wave equation. Define eigen functions and eigen values.	*CO1/ CO2*	*PO1*	**8**
	b)		Define phase velocity and group velocity. Derive an expression for group velocity on the basis of the superposition of waves.	*CO1/CO2*	*PO1*	**8**
	c)		Find the phase velocity and group velocity of an electron whose de-Broglie wavelength is 1.2 Å.	*CO2*	*PO1*	**4**
			UNIT - II			
3	a)		Mention the postulates of quantum free electron theory and describe how quantum free electron theory has been successful in overcoming any two failures of classical free electron theory.	*CO1/ CO2*	*PO1*	**8**
	b)		State Wiedmann - Franz's law. Derive an expression for thermal conductivity of a conductor using classical free electron theory.	*CO1/ CO2*	*PO1*	**8**
	c)		Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy level is occupied.	*CO2*	*PO1*	**4**

			UNIT - III			
	4	a)	Derive an expression for internal field in the case of a one-dimensional array of atoms in dielectric solids.	*CO1/ CO2*	*PO1*	**8**
		b)	Explain the Fermi level in intrinsic and extrinsic semiconductors with schematic diagrams. Derive an expression for the Fermi level in an intrinsic semiconductor.	*CO1/ CO2*	*PO1*	**8**
		c)	The atomic weight and density of sulphur are 32 and 2.08×10^{3} kg/m^3 respectively. The electronic polarizability of the atom is 3.28×10^{-40} Fm^2. If a sulphur solid has a cubic structure, calculate its dielectric constant.	*CO2*	*PO1*	**4**
			UNIT - IV			
	5	a)	Derive an expression for an energy density of radiation under equilibrium conditions in terms of Einstein's coefficients.	*CO1/ CO2*	*PO1*	**8**
		b)	Discuss the classification of optical fibers with neat sketch.	*CO1/ CO2*	*PO1*	**8**
		c)	A pulsed laser emits photons of wavelength 780 nm with 20 mw average power/ pulse. Calculate the number of photons contained in each pulse if the pulse duration is 10 ns.	*CO2*	*PO1*	**4**
			OR			
	6	a)	What is numerical aperture. Derive an expression for the numerical aperture of an optical fiber and then arrive at the condition of ray propagation.	*CO1/ CO2*	*PO1*	**8**
		b)	Explain the construction and working of a semiconductor laser.	*CO1/ CO2*	*PO1*	**8**
		c)	Calculate the number of modes that can propagate inside an optical fiber with core refractive index of 1.53 and cladding refractive index of 1.50. Given the core radius=50 μm, wavelength= 1 μm.	*CO2*	*PO1*	**4**
			UNIT - V			
	7	a)	Give the theory of forced vibration and deduce the expression for amplitude.	*CO1/ CO2*	*PO1*	**8**
		b)	Explain Logarithmic decrement, relaxation time and quality factor.	*CO1/ CO2*	*PO1*	**8**
		c)	A 3.94 kg block extends a spring 15.7 cm from its unstretched position. The block is removed and a 0.520 kg object is suspended from the same spring and is set into oscillations. Find the period of oscillation.	*CO2*	*PO1*	**4**

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