U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2025 Semester End Main Examinations

Programme: B.E. **Semester: I / II**

Branch: CS / AI&ML / BT **Duration: 3 hrs.**

Course Code: 22PH1BSPCS / 22PH2BSPCS **Max Marks: 100**

Course: Applied Physics for Computer Science Stream

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

Physical constants:

Mass of electron, $m_e = 9.1\times10^{-31}$ kg
Electronic charge, $e = 1.602\times10^{-19}$ C
Boltzmann constant, $k_B = 1.38\times10^{-23}$ J/K
Permittivity of free space, $\varepsilon_o = 8.85\times10^{-12}$ F/m
Speed of light, $c = 3\times10^{8}$ m/s
Planck constant, $h = 6.626\times10^{-34}$ Js
Mass of neutron, $m_n = 1.67\times10^{-27}$ kg
Mass of proton, $m_p = 1.67\times10^{-27}$ 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.

		MODULE - I	CO	PO	Marks
1	a)	Explain the general conditions for laser amplification and the basic requisites of laser system.	CO1	PO1	**08**
	b)	Discuss the block diagrams of point-to-point communication using optical fiber. Mention any four disadvantages of optical fiber.	CO1	PO1	**08**
	c)	An optical fiber of refractive indices 1.45 and 1.4 for core and cladding respectively kept in water of refractive index 1.33. Find the numerical aperture, fractional index change and acceptance angle of the given fiber.	CO1	PO2	**04**
		OR			
2	a)	Explain the importance of population inversion in laser system. Discuss the construction and working of semiconductor diode laser with neat diagrams.	CO1	PO1	**08**
	b)	What is attenuation? Discuss various reasons for attenuation in optical signal in optical communication.	CO1	PO1	**08**
	c)	The ratio of population of two energy levels is 2.059×10^{-31}. Find the wavelength of light emitted by spontaneous emission at 300K.	CO1	PO2	**04**
		MODULE - II			
3	a)	What is group velocity and phase velocity? Obtain the relation between group velocity and particle velocity.	CO1	PO1	**08**

		b)	Define Eigen function and Eigen values. Setup one dimension time independent Schrödinger's wave equation.	*CO1*	*PO1*	**08**
		c)	In a measurement of position and momentum that involved an uncertainty of 0.003% in speed. The speed of an electron was found to be 800 m/s. Calculate the corresponding uncertainty that arises in determining its position.	*CO1*	*PO2*	**04**
			OR			
	4	a)	State Heisenberg's uncertainty principle. Using this principle show that the electron cannot pre-exist inside the nucleus.	*CO1*	*PO1*	**08**
		b)	Apply the time independent Schrodinger wave equation, discuss the solution for a particle in one dimensional potential well of infinite height. Hence obtain the energy of a particle and normalized wave function.	*CO1*	*PO1*	**08**
		c)	An electron is accelerated under a potential 55 kV from rest. Find the wavelength, momentum and energy of the electron.	*CO1*	*PO2*	**04**
			MODULE - III			
	5	a)	What is Fermi factor? With a neat graph explain the variation of Fermi factor with temperature and energy.	*CO1*	*PO1*	**08**
		b)	Define dielectric polarization. Explain any three-polarization mechanism with illustration.	*CO1*	*PO1*	**08**
		c)	The dielectric constant of Helium gas at NTP is 1.0000684. Calculate the electronic polarizability of Helium atoms if the gas contains $2.7x10^{25}$ atoms per m^3 and hence evaluate the radius of the Helium atoms.	*CO1*	*PO2*	**04**
			OR			
	6	a)	List the assumption of quantum free electron theory. Discuss any two merits of quantum free electron theory.	*CO1*	*PO1*	**08**
		b)	Obtain an expression for internal field of a one-dimensional array of atoms in dielectric solids.	*CO1*	*PO1*	**08**
		c)	Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy is occupied.	*CO1*	*PO2*	**04**
			MODULE – IV			
	7	a)	Define Hall effect. Arrive at an expression for Hall voltage in terms of Hall coefficient of a semiconductors.	*CO1*	*PO1*	**08**
		b)	What is Meissner effect? Explain type I and type II superconductors with M-H graph.	*CO1*	*PO1*	**08**
		c)	The critical field of Niobium is $1x10^5$ A/m at 8 K and $2x10^5$ A/m at 0 K. Find the transition temperature of the element.	*CO1*	*PO2*	**04**

			OR			
	8	a)	Obtain an expression for electron concentration in conduction band of an intrinsic semiconductor.	*CO1*	*PO1*	**08**
		b)	Discuss temperature dependance of resistivity in conductor and superconductor. Discuss high temperature superconductors with an example.	*CO1*	*PO1*	**08**
		c)	Compute the concentration of intrinsic charge carriers in a germanium crystal at 300 K. Given E_g =0.72 eV and assume $m_e^* = m_h^*$.	*CO1*	*PO2*	**04**
			MODULE - V			
	9	a)	Show that Pauli matrices are unitary matrices.	*CO1*	*PO1*	**08**
		b)	Discuss the CNOT gate and its operation on four different input states.	*CO1*	*PO1*	**08**
		c)	Show that S gate can be formed by connecting two T gate in series.	*CO1*	*PO2*	**04**
			OR			
	10	a)	State Moore's law. List out the differences between classical and quantum computing.	*CO1*	*PO1*	**08**
		b)	Discuss Hadamard gate and phase gate with matrix, circuit and truth table.	*CO1*	*PO1*	**06**
		c)	Find the inner product of $\|A\rangle = \begin{bmatrix} a \\ ib \end{bmatrix}$ with itself.	*CO1*	*PO2*	**06**

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