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: ECE and EEE **Duration: 3 hrs.**

Course Code: 22PH1BSPEE / 22PH2BSPEE **Max Marks: 100**

Course: Applied Physics for Electrical 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 de-Broglie hypothesis and derive an expression for de Broglie wavelength of an electron in terms of kinetic energy.	CO1	PO 1	**8**
	b)	State Heisenberg's uncertainty principle. Based on this principle, prove the nonexistence of electrons in the nucleus of an atom.	CO1	PO1	**8**
	c)	An electron is trapped in a potential well of width 0.1 nm and infinite height. Find the energy of electron in the first excited state.	CO1	PO2	**4**
		OR			
2	a)	What is group velocity? Show that group velocity is equal to particle velocity.	CO1	PO1	**8**
	b)	Solve Schrodinger wave equation for a particle in 1-D potential well of infinite height and hence obtain the normalized wave function and energy Eigen values.	CO1	PO1	**8**
	c)	An electron has a speed of $4.8\text{x}10^{5}$ m/s and is measured to an accuracy of 0.012%. With what accuracy position of an electron can be located?	CO1	PO2	**4**
		Module – II			
3	a)	Derive an expression for energy density of radiation in terms of Einstein's A & B coefficients.	CO1	PO1	**8**
	b)	Mention any three advantaged of optical fibers. With neat block diagrams, explain the application of optical fiber in point-to-point communication.	CO1	PO1	**8**

		c)	A laser operating at 632 nm emits 3.2 x 10^{16} photons per second. Calculate percentage of power converted into coherent light energy if the input power is 100 W.	*CO1*	*PO2*	**4**
			OR			
	4	a)	With neat diagrams, explain the construction and working of He-Ne laser.	*CO1*	*PO1*	**8**
		b)	What is numerical aperture? Derive an expression for numerical aperture of an optical fiber and hence arrive at the condition for propagation of light.	*CO1*	*PO1*	**8**
		c)	Find the attenuation in an optical fiber of length 500 m, when a light signal of power 100 mW emerges out of the fiber with a power of 90 mW.	*CO1*	*PO2*	**4**
			Module - III			
	5	a)	Mention the postulates of quantum free electron theory. Discuss any two merits of quantum free electron theory.	*CO1*	*PO1*	**8**
		b)	Discuss different types of polarizations in dielectric materials due to applied electric field with suitable diagrams.	*CO1*	*PO1*	**8**
		c)	Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above the Fermi energy is occupied.	*CO1*	*PO2*	**4**
			OR			
	6	a)	Derive an expression for internal field in the case of linear array of atoms in solid dielectric.	*CO1*	*PO1*	**8**
		b)	Define Fermi energy and Fermi temperature. Discuss the dependence of Fermi factor on temperature and energy with suitable graph.	*CO1*	*PO1*	**8**
		c)	An elemental solid dielectric material has polarizability $7x10^{-40}$ Fm^2. Assuming the internal field is to be Lorentz field, calculate the dielectric constant for the material if the material has $3x10^{28}$ atoms/m^3.	*CO1*	*PO2*	**4**
			Module - IV			
	7	a)	Explain Hall effect in semiconductors. Obtain an expression for Hall voltage in terms of Hall co-efficient.	*CO1*	*PO1*	**8**
		b)	Obtain an expression for concentration of electrons in conduction band of a semiconductor.	*CO1*	*PO1*	**8**
		c)	The intrinsic carrier density in n-type silicon is 1.5 x 10^{19} /m^3 and density of phosphorous is 10^{23} atoms/m^3. The electron and hole mobility are 0.135 m^2/Vs and 0.048 m^2/Vs, respectively. What is its conductivity before and after addition of atoms?	*CO1*	*PO2*	**4**

			OR			
	8	a)	Obtain an expression for electrical conductivity of semiconductor and hence arrive at energy band gap relation.	*CO1*	*PO1*	**8**
		b)	Discuss the principle, construction and working of a semiconductor diode LASER with suitable diagrams.	*CO1*	*PO1*	**8**
		c)	Calculate the power responsivity of a photodiode having quantum efficiency of 75% operating at a wavelength of 550 nm.	*CO1*	*PO2*	**4**
			Module - V			
	9	a)	What are soft and hard magnetic materials? Mention any four properties and two applications.	*CO1*	*PO1*	**8**
		b)	What are superconductors? Describe different types of superconductors with M-H graph and examples.	*CO1*	*PO1*	**8**
		c)	Calculate the flux density of a material placed in magnetic field of intensity 1000 A/m. The magnetic susceptibility is -0.42×10^{-3}.	*CO1*	*PO2*	**4**
			OR			
	10	a)	What are ferromagnetic materials? Explain the hysteresis curve of ferromagnetic material based on domain concept.	*CO1*	*PO1*	**8**
		b)	Elucidate BCS theory of superconductivity and show that superconductors are diamagnetic material.	*CO1*	*PO1*	**8**
		c)	The transition temperature for lead is 7.2 K. However at 5 K, it loses the superconductivity if subjected to magnetic field of 3.3×10^4 A/m. Find the maximum value of magnetic field which will allow the material to retain its superconductivity at 0 K.	*CO1*	*PO2*	**4**

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