U.S.N.										

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

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

Programme: B.E. **Semester: I**
Branch: EEE and ECE **Duration: 3 Hours**
Course Code: 22PH1BSPEE **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)	Define phase velocity and group velocity. Deduce the relation between group and phase velocity.	CO1	PO 1	**8**
	b)	Mention the properties of the wave function. Discuss the Eigen function, Eigen value and probability density for the first two energy states of a particle inside a one-dimensional potential well of infinite height and finite width.	CO1	PO1	**8**
	c)	A particle of mass 0.65 MeV/C^2 has a kinetic energy of 80 eV. Find the de-Broglie wavelength, group velocity and Phase velocity of the de Broglie wave.	CO1	PO2	**4**
		OR			
2	a)	State and explain Heisenberg's uncertainty principle. Using this principle show that a free electron cannot exist within the nucleus of an atom.	CO1	PO1	**8**
	b)	Apply Schrodinger's wave equation to a particle confined in a one dimensional infinitely deep potential well to obtain normalized wave functions and energy Eigen values.	CO1	PO1	**8**
	c)	Estimate the potential difference through which a proton is needed to be accelerated so that its de Broglie wavelength becomes equal to 0.5 Å. Given the mass of a proton, 1.673×10^{-27} kg.	CO1	PO2	**4**

			Module - II			
	3	a)	Derive an expression for the energy density of radiation under equilibrium conditions in terms of Einstein's coefficients.	CO1	PO1	**8**
		b)	Discuss the classification of optical fibers with suitable diagrams.	CO1	PO1	**8**
		c)	The attenuation coefficient of an optical fiber having length 1000 m is found to be 0.90 dB/km. If the output power is 90 mW, then calculate the input power.	CO1	PO2	**4**
			OR			
	4	a)	What is numerical aperture? Derive an expression for the numerical aperture of an optical fiber and then arrive at the condition for light propagation.	CO1	PO1	**8**
		b)	Discuss the construction and working of the He-Ne laser with an energy level diagram.	CO1	PO1	**8**
		c)	He-Ne LASER is emitting a beam with an average power of 4.5 mW. Find the number of photons emitted per second by the LASER. Given the wavelength of the emitted radiation is 6328 Å.	CO1	PO2	**4**
			Module - III			
	5	a)	Mention the postulates of quantum free electron theory. Explain any two merits of quantum free electron theory.	CO1	PO1	**8**
		b)	Define polarization in dielectrics. Discuss any three types of polarization mechanisms in dielectrics with suitable schematic diagrams.	CO1	PO1	**8**
		c)	The dielectric constant of Helium at 0 ^{o}C is 1.000074. The density of atom is 2.7×10^{25} atoms/m^3. Calculate the dipole moment induced in each atom when the gas is in an electric field of 3×10^4 V/m.	CO1	PO2	**4**
			OR			
	6	a)	Define Fermi energy and Fermi factor. Discuss the variation of Fermi factor with temperature using graphical representation.	CO1	PO1	**8**
		b)	What is internal field? Deduce an expression for internal field in one dimensional array of atoms in dielectric solids.	CO1	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 will be occupied.	CO1	PO2	**4**
			Module - IV			
	7	a)	Obtain an expression for concentration of electrons in conduction band of a semiconductor.	CO1	PO1	**8**

		b)	With suitable diagram explain the phenomenon of Hall Effect in semiconductors. Obtain the expression for Hall voltage and Hall coefficient.	CO1	PO1	**8**
		c)	The resistivity of intrinsic silicon at 300 K is 3000 Ωm. Assuming electron and hole mobilities as 0.17 m^2/v.s and 0.035 m^2/v.s respectively, calculate the intrinsic carrier concentration.	CO1	PO2	**4**
			OR			
	8	a)	Show that the Fermi level in intrinsic semiconductors lies midway in the energy gap. Explain and indicate the Fermi level in intrinsic and extrinsic semiconductors.	CO1	PO1	**8**
		b)	Discuss the principle, construction and working of a semiconductor diode LASER with suitable diagrams.	CO1	PO1	**8**
		c)	The Hall coefficient of a specimen of doped silicon is found to be $3.66 \times 10^{-4} m^3$/coulomb. The resistivity of the specimen is 9.93×10^{-3} Ω-m. Find the mobility and density of the charge carrier, assuming single carrier conduction.	CO1	PO2	**4**
			Module - V			
	9	a)	Discuss Weiss's theory of magnetic domains. Explain magnetic hysteresis on the basis of domain theory.	CO1	PO1	**8**
		b)	What is Meissner effect?? Discuss Type I and Type II superconductors with M-H graph and examples.	CO1	PO1	**8**
		c)	Calculate the critical current for a wire of lead having a diameter of 1 mm at 5.2 K. Critical temperature for lead is 8.18 K and $H_0 = 6.5 \times 10^4$ Am^{-1}.	CO1	PO2	**4**
			OR			
	10	a)	What is superconductivity? Discuss the dependence of resistivity on temperature of a superconductor with that of a normal conductor.	CO1	PO1	**8**
		b)	Explain the classification of magnetic materials. Distinguish between soft and hard magnetic materials with characteristic features and applications.	CO1	PO1	**8**
		c)	The magnetic susceptibility of a material at room temperature is 0.82×10^{-8}. Calculate its magnetization under the action of a magnetic induction of 0.25 Tesla.	CO1	PO2	**4**

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