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: Common to all Branches **Duration: 3 hrs.**
Course Code: 21PY1BSPHY / 21PY2BSPHY **Max Marks: 100**
Course: ENGINEERING PHYSICS

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

Planck's constant, $h = 6.63 \times 10^{-34}$ Js
Boltzmann constant, $k = 1.38 \times 10^{-23}$ J/K
Mass of electron, $m_e = 9.11 \times 10^{-31}$ kg
Velocity of light, $c = 3 \times 10^{8}$ m/s
Mass of neutron, $m_n = 1.675 \times 10^{-27}$ kg
Avogadro's number, $N_A = 6.02 \times 10^{26}$ /k mol
Charge of electron, $e = 1.602 \times 10^{-19}$ C
Permittivity of vacuum, $\epsilon_o = 8.85 \times 10^{-12}$ F/m

				Marks
			MODULE – I	
1	a)		Define group velocity. Derive an expression for de Broglie wavelength of matter waves using group velocity.	**8**
	b)		State Heisenberg's Uncertainty Principle. Show that an electron cannot exist inside the nucleus using the HUP.	**8**
	c)		An electron is bound in one dimensional box of width 4×10^{-10} m. What will be its minimum energy?	**4**
			OR	
2	a)		State de Broglie's hypothesis. Arrive at the expression for group velocity using the concept of superposition of waves.	**8**
	b)		What are the properties of wave function. Set up the one-dimensional time independent Schrodinger's wave equation for a moving particle in a quantum mechanical system.	**8**
	c)		An electron is accelerated by a potential difference of V volts. Show that the de Broglie wavelength is equal to $[\frac{12.27\ \text{Å}}{\sqrt{V}}]$.	**4**
			MODULE – II	
3	a)		Obtain an expression for energy density of radiation under thermal equilibrium condition in terms of Einstein's coefficients.	**8**
	b)		Illustrate with neat diagrams different types of optical fibers.	**8**
	c)		The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K.	**4**

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.

			OR	
	4	a)	Define numerical aperture. Derive an expression for numerical aperture of an optical fibers with suitable diagram.	**8**
		b)	Define attenuation. Discuss the reasons for attenuation in optical fibers.	**8**
		c)	The fractional index change of optical fiber and refractive index of the core are 0.00515 and 1.533, respectively. Calculate the refractive index of the cladding and the numerical aperture.	**4**
			MODULE – III	
	5	a)	Define thermal conductivity. Derive an expression for thermal conductivity of a conductor using classical free electron theory.	**8**
		b)	Mention the postulates of quantum free electron theory and discuss in detail any two successes of quantum free electron theory.	**8**
		c)	Find the electron density of a metal with Fermi energy 3 eV.	**4**
			OR	
	6	a)	What is Fermi factor? Explain the variation of Fermi factor with energy and temperature using suitable graph.	**8**
		b)	With a neat diagram, explain the experimental determination of conductivity of a material using Forbe's method.	**8**
		c)	Find the temperature at which there is 1% probability that a state with energy 0.5 eV above Fermi energy is occupied.	**4**
			MODULE – IV	
	7	a)	Derive an expression for concentration of electrons in conduction band of a semiconductor.	**8**
		b)	Define polarization. Discuss different types of polarization mechanisms with neat schematic diagrams.	**8**
		c)	Calculate the intrinsic carrier concentration of Germanium if the mobility of electrons and holes are respectively, 0.36 m^2/Vs and 0.14 m^2/Vs and the resistivity is 2.2 Ω-m.	**4**
			OR	
	8	a)	Obtain an expression for internal electric field in one dimensional array of solid or liquid dielectrics.	**8**
		b)	Obtain an expression for Fermi level in intrinsic semiconductor. Explain and indicate the Fermi level in an intrinsic and extrinsic semiconductor with energy level diagram.	**8**
		c)	The dielectric constant of Helium at 0 ^oC is 1.000074. The density of atom is $2.7x10^{25}$ atoms/m^3. Calculate the dipole moment induced in each atom when the gas is in an electric field of $3x10^4$ V/m.	**4**
			MODULE – V	
	9	a)	What are the forced oscillations? Arrive at an expression for amplitude in forced oscillation.	**8**
		b)	Derive an expression for total energies of a simple harmonic oscillator. Schematically variation represent the kinetic energy, potential energy and total energy with time.	**8**
		c)	A mass of 1 kg causes an extension of 0.06 m in a spring and the	**4**

			system is set for oscillation. Compute the angular frequency and the force constant of the spring.	
			OR	
	10	a)	Establish the differential equation for damped vibration and obtain the general solution.	**8**
		b)	Derive an equation of motion for SHM and mention its solution.	**8**
		c)	A free particle is executing simple harmonic motion in a straight line. The maximum velocity it attains during any oscillation is 62.8 m/s. find the frequency of oscillation, if its amplitude is 0.5 m.	**4**

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