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:3hrs.**
Course Code: 18PY1BSPHY / 18PY2BSPHY **MaxMarks:100**
Course: Applied 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

		UNIT-I	
1	a)	Define Phase velocity and Group velocity. Derive an expression for de-Broglie wavelength using the concept of group velocity.	**8**
	b)	State Heisenberg's uncertainty principle. Show the non-existence of electron inside the nucleus by applying the Heisenberg's uncertainty principle.	**8**
	c)	An electron is bound in an one dimensional potential well of width 2 A^0 and infinite wall height. Find its energy in the first and second excited state.	**4**
		OR	
2	a)	State de-Broglie hypothesis. Derive the de-Broglie wave length of an electron accelerated under a potential "V" from rest.	**8**
	b)	Obtain an energy Eigen values for a particle in one dimensional potential well of infinite height and finite width.	**8**
	c)	The position and momentum of 1.0 keV electrons are simultaneously measured. If the position is located within $1A^0$, what is the percentage of uncertainty in momentum?	**4**
		UNIT -II	
3	a)	What is thermal conductivity? With a neat labelled diagram discuss the theory of determination of thermal conductivity of a poor conductor using Lee-Charlton's method.	**8**
	b)	Define Fermi factor. Explain the variation of Fermi factor with energy and temperature using suitable graph.	**8**

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	c)	Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy is occupied.	**4**
		OR	
4	a)	State and explain Wiedemann-Franz law. Derive an expression for thermal conductivity of a conductor using classical free electron theory.	**8**
	b)	With a neat labelled diagram explain the experimental determination of thermal conductivity of a good conductor using Forbes method.	**8**
	c)	Find the Fermi temperature and Fermi velocity in copper wire with Fermi energy of 7 eV.	**4**
		UNIT -III	
5	a)	With a neat schematic diagrams, explain different polarization mechanisms	**8**
	b)	Obtain an expression for internal field in case of one-dimensional array of atoms in dielectric solids.	**8**
	c)	The dielectric constant of Helium gas at NTP is 1.0000684. Find the electronic polarizabiity of Helium atoms if the gas contains $2.7x10^{25}$ atoms per m^3 and hence evaluate the radius of the Helium atoms.	**4**
		OR	
6	a)	Obtain an expression for electron concentration in conduction band of semiconductor above absolute zero.	**8**
	b)	Deduce an expression for Fermi level in an intrinsic semiconductor. Explain and indicate the Fermi level in intrinsic and extrinsic semiconductors schematically using energy level diagram.	**8**
	c)	Calculate the conductivity at 300 K in Germanium with electrons mobility of 0.4 $m^2V^{-1}s^{-1}$, holes mobility of 0.2 $m^2V^{-1}s^{-1}$ and intrinsic carrier density 2×10^{19} m^{-3}.	**4**
		UNIT - IV	
7	a)	What is acceptance angle of an optical fiber? Arrive at an expression for numerical aperture of an optical fiber.	**8**
	b)	Define attenuation in optical fiber. Explain the reasons for power loss in optical fiber.	**8**
	c)	An optical fiber of refractive indices are 1.55 and 1.5 for core and cladding, respectively. If the fiber is kept in water of refractive index 1.33, find the acceptance angle, Numerical aperture of the given fiber and fractional index change.	**4**
		OR	
8	a)	With a neat label diagram, explain the construction and working of Helium – Neon gas laser.	**8**
	b)	What is Holography? With a neat labeled diagram, explain recording and reconstruction of holograms.	**8**
	c)	The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted by spontaneous emission at 300 K.	**4**

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		UNIT -V	
9	a)	Establish the differential equation of motion for a damped osilater and obtain an expression for displacement. Discuss the case of over damping.	**8**
	b)	What is simple harmonic motion (SHM)? Show that the total energy of SHM is conserved.	**8**
	c)	A mass of 250 gm attached to a spring is executing simple harmonic motion with a time period 6 s. Find the spring constant.	**4**
		OR	
10	a)	Establish the differential equation for forced vibration and also obtain an expression for amplitude and phase.	**8**
	b)	Define Resonance. Explain in brief Nuclear magnetic resonance (NMR) and list its two applications.	**8**
	c)	The Q factor of a spring loaded with 0.3 kg is 60. It vibrates with a frequency of 2 Hz. Calculate the force constant and mechanical resistance.	**4**

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