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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

I & II Semester, B.E. – Supplementary Semester End Examination; Nov. / Dec. - 2023

Applied Physics

(Electrical and Electronics Engineering Stream)

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the fundamental concepts of physics to understand advanced principles of oscillations, waves, quantum mechanics, materials properties, photonics, electrical and thermal conductivity of materials.

CO2: Identify the engineering applications of oscillations, waves, quantum mechanics, dielectric and superconducting properties of materials, photonics, electrical and thermal conductivity of materials with basic knowledge of physics.

CO3: Formulate the needed mathematical expressions to answer advanced engineering problems using theoretical knowledge of applied physics.

CO4: Solve the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and acoustics by the knowledge of mathematics.

CO5: Analyze the experimental results with theory by constructing the circuit/Setting up the experiment related to applied physics.

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for a Maximum of* ***18 marks*** *from each unit.*

Physical constants: *Electron mass, $m = 9.11\times10^{-31}$ kg, Electron charge, $e = 1.602\times10^{-19}$ C; Velocity of light, $c = 3\times10^{8}$ ms^{-1}; Planck's constant, $h = 6.626\times10^{-34}$ Js; Boltzmann constant, $K = 1.38\times10^{-23}$ JK^{-1}; Avogadro number, $N = 6.025\times10^{23}$/mole; Permittivity of free space, $\varepsilon_o = 8.85\times10^{-12}$ Fm^{-1}.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	State de-Broglie hypothesis of matter waves.	2	L1	CO1	PO1
b.	Define superconductivity.	2	L1	CO1	PO1
c.	Define Fermi temperature and Fermi velocity.	2	L1	CO1	PO1
d.	What is fractional index change? Write its equation.	2	L1	CO1	PO1
e.	State law of mass action.	2	L1	CO1	PO1
	II : PART – B	**90**			
	UNIT – I	**18**			
2 a.	State Heisenberg's uncertainty principle. Using this principle prove that an electron does not exist inside the nucleus of an atom.	9	L1	CO1,3	PO1
b.	Using time-independent Schrodinger's wave equation, derive an expression for Eigen function and Eigen values for a particle in one – dimensional potential well of infinite height.	9	L1	CO3	PO1
c.	i) Compute the energy of an electron associated with the wavelength of 0.1 nm	4	L2	CO4	PO2
	ii) In a measurement of position and velocity of an electron moving with a speed of 6 x 10^5 m/s with any accuracy of 0.01%, calculate the uncertainty in its position.	5	L2	CO4	PO2

Contd…2

		Marks	L	CO	PO
	UNIT - II	**18**			
3 a.	What is dielectric polarization? Explain the four types of dielectric polarization mechanisms.	9	L1	CO1,2	PO1
b.	What is critical field? Explain type-I and Type-II superconductors.	9	L1	CO2	PO1
c.	i) The dielectric constant of sulphur is 3.4. Assuming the internal field is Loreortz's field, calculate the electronic polarizability of sulplur. Given; density of sulphur = 2.07 x 10^3 kg/m^3 and atomic weight = 32.07	5	L2	CO4	PO2
	ii) Calculate the critical field at 7 K for a superconducting material, given that its transition temperature is 7.18 K and critical magnetic field at 0 K is 65000 A/m.	4	L2	CO4	PO2
	UNIT - III	**18**			
4 a.	Define Fermi factor and explain the variation of Fermi factor with energy and temperature.	9	L1	CO1,2	PO1
b.	What is a magnetic domain? Explain soft and hard magnetic materials. With examples to each.	9	L1	CO1,2	PO1
c.	i) Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K.	6	L2	CO4	PO2
	ii) The magnetic susceptibility of a material at room temperature is 0.82 x 10^{-8}. Calculate its magnetization under the action of an applied magnetic field of strength 0.25 Tesla.	3	L2	CO4	PO2
	UNIT - IV	**18**			
5 a.	Derive an expression for electron concentration in an intrinsic semiconductor.	9	L1	CO3	PO1
b.	Discuss the variation of Fermi level in intrinsic and extrinsic semiconductors with temperature. Show that the Fermi level lies in the middle of energy band gap in case of intrinsic semiconductor.	9	L1	CO2	PO1
c.	i) Derive an expression for electrical conductivity of an intrinsic semiconductor.	5	L2	CO4	PO2
	ii) The electron and hole mobilities of pure silicon are 0.14 $m^2/V/s$ and 0.05$m^2V^{-1}s^{-1}$ respectively at a certain temperature. If the intrinsic carrier concentration is 1.5 x $10^{16}/m^3$, calculate the conductivity of silicon.	4	L2	CO4	PO2

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	UNIT - V	**18**			
6 a.	Derive an expression for energy density of radiation at thermal equilibriums in terms of Einstein coefficients.	9	L1	CO3	PO1
b.	With a neat diagram, explain different types of optical fibers.	9	L1	CO2	PO1
c.	i) A medium in thermal equilibrium at temperature 300 K has two energy levels with a wave length separation of 1 μm. Find the ratio of population densities of the upper and lower levels.	4	L2	CO4	PO2
	ii) Calculate the number of modes that the fiber can support, having core diameter 40 μm, with refractive indices 1.55 and 1.5 for core and cladding respectively, if the wavelength of light is 1.400 x 10^{-7} m propagating through it.	5	L1	CO4	PO2

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