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BPHYE102/202

First/Second Semester B.E./B.Tech. Degree Examination, June/July 2024
Applied Physics for EEE Stream

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Handbook is permitted.

Module – 1			M	L	C
Q.1	a.	State de Broglie hypothesis and set up one – dimensional time independent Schrodinger Wave equation.	9	L2	CO1
	b.	Define a Wavepacket and explain the terms Phase velocity and Group velocity and mention their expressions.	6	L2	CO1
	c.	In measurement of position and momentum that involved an uncertainty of 0.003%, the speed of an electron was found to be 800ms^{-1} . Calculate the corresponding uncertainty that arises in determining its position.	5	L3	CO1
OR					
Q.2	a.	Using the time independent Schrodinger wave equation, obtain the expression for the normalized wave function for a particle in one dimensional potential well of infinite height.	9	L2	CO1
	b.	Using uncertainty principle, show that an electron cannot exist within the nucleus of an atom.	6	L2	CO1
	c.	An electron is bound in an one dimensional potential well of width $1\text{\AA}$, but of infinite wall height. Find its energy values in the ground and in the first two excited states.	5	L3	CO1
Module – 2					
Q.3	a.	Define Fermi energy and Fermi factor. Discuss the variation of Fermi factor with temperature and energy.	9	L2	CO2
	b.	Define Dielectric polarization and describe the different polarization mechanisms.	7	L2	CO2
	c.	Calculate the probability of an electron occupying an energy level 0.02eV above Fermi level at 200K in a material.	4	L3	CO2
OR					
Q.4	a.	Derive Clausius – Mossotti equation.	6	L2	CO2
	b.	Explain BCS theory of Superconductivity. Write a short note on Maglev vehicles.	9	L2	CO2
	c.	An elemental solid dielectric material has polarizability $7 \times 10^{-40} \text{Fm}^2$. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has $3 \times 10^{28} \text{atoms/m}^3$.	5	L3	CO2

Module – 3					
Q.5	a.	Define Induced absorption , Spontaneous emission and Stimulated emission. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein's co-efficient.	10	L2	CO1
	b.	Explain different types attenuations in optical fibers.	6	L2	CO1
	c.	A medium in thermal equilibrium at temperature 300K has two energy levels with a wavelength separation of 1 μ m. Find the ratio of population densities of the upper and lower levels.	4	L3	CO1
OR					
Q.6	a.	Describe the construction and working of carbon dioxide laser.	8	L2	CO1
	b.	With neat diagram, derive an expression for numerical aperture of an optical fiber and arrive at the condition for propagation.	7	L2	CO1
	c.	An optical fiber has a core material with refractive index 1.55 and its cladding material has a refractive index of 1.50. The light is launched into it in air. Calculate its numerical aperture, the acceptance angle and also the fractional index change.	5	L3	CO1
Module – 4					
Q.7	a.	Describe the vector operator ∇ and explain the concepts of gradient, divergence and curl.	7	L2	CO3
	b.	Explain the Gauss's law in electrostatics and magnetism. Express the same in their differential forms.	8	L2	CO3
	c.	Given $\vec{A} = (3x^2 + y + az) \hat{a}_x + (bx - 5y^3 - 2z) \hat{a}_y + (2x + cy + 3z^2) \hat{a}_z$. For what values of a, b, and c the vector $\vec{A}$ is irrotational?	5	L3	CO3
OR					
Q.8	a.	Derive Gauss's divergence theorem and also mention the Stoke's theorem.	7	L2	CO3
	b.	Derive the electromagnetic wave equation using Maxwell's equation in free space.	8	L2	CO3
	c.	Determine the constant C such that, the vector $\vec{A} = (x + ay) \hat{a}_x + (y + bz) \hat{a}_y + (x + cz) \hat{a}_z$ is Solenoidal.	5	L3	CO3
Module – 5					
Q.9	a.	Show that the Fermi level lies in the middle of the energy gap for an intrinsic semiconductor.	6	L2	CO4
	b.	What is Hall effect? Obtain the expression for Hall voltage in terms of Hall co-efficient.	9	L2	CO4

	c.	In a diffraction grating experiment, the laser light undergoes third order diffraction with diffraction angle of 11.7° . The grating constant is 10^{-5}m and the distance between the grating and laser source is 1m, find the wavelength of laser light?	5	L3	CO5
OR					
Q.10	a.	Obtain the expression for electrical conductivity ion extrinsic and intrinsic semiconductors.	7	L2	CO4
	b.	Describe with energy band diagram, the construction and working of a semiconductor diode laser.	8	L2	CO4
	c.	Determine the resonance frequency of an LCR series circuit with inductance = 0.5 henry , Capacitance = 0.45 , Microfarad and resistance = 300Ω .	5	L3	CO5

COs and Pos Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	1	-	-	-	-	-	-	2
CO5	3	2	1	-	2	-	-	3	3	-	-	2

Note : Level – 3 : Highly Mapped , Level – 2 : Moderately Mapped ,
Level – 1 : Low Mapped.

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