CBCS SCHEME

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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 1A° , 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 7×10^{-40} Fm^2. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has 3×10^{28} 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 1μm. 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 and 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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