CBCS SCHEME

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BPHYE102/202

First/Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

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. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.
4. Constants: Planck's constant 'h' = 6.63×10^{-34} Js, Boltzman constant 'k' = 1.38×10^{-23} JK^{-1}
Mass of electron 'm' = 9.11×10^{-31} kg. Charge of electron 'e' = 1.603×10^{-19} C
Velocity of light in free space 'C' = 3×10^{8} m/s, Permittivity (free space) 'ε_0'=8.854×10^{-12} Fm^{-1}

		Module – 1	M	L	C
Q.1	a.	Using de-Broglie's hypothesis setup time independent Schrodinger wave equation for a particle in one-dimension.	07	L2	CO1
	b.	State and explain Heisenberg's uncertainty principle. Using uncertainty principle, prove that electron does not exist inside the nucleus.	09	L2	CO1
	c.	Find the de-Broglie wavelength of the electron in its ground state, if it is confined in an infinite potential well of width 10 nm.	04	L3	CO1
		OR			
Q.2	a.	Explain briefly (i) Matter waves (ii) Group velocity (iii) Wave function	06	L2	CO1
	b.	Find the eigen function and energy eigen values for particle in a one dimensional potential well of infinite height.	10	L2	CO1
	c.	A particle of mass 9.1×10^{-31} kg is confined in a region of width 8×10^{-9} m. Calculate the minimum uncertainty in the measurement of its velocity.	04	L3	CO1
		Module – 2			
Q.3	a.	What is Meissner effect? Discuss types of superconductors with examples based in critical field.	08	L2	CO2
	b.	What are polar dielectrics? Describe the different polarization mechanisms.	08	L2	CO2
	c.	Calculate the probability of an electron occupying an energy level 0.02 eV below the Fermi level in a metal at thermal equilibrium (300 K).	04	L3	CO2
		OR			
Q.4	a.	What is Fermi factor? Discuss the dependence of Fermi factor on temperature and energy.	07	L2	CO2
	b.	What is internal field in dielectrics? Derive Clausius – Mossotti equation for an isotropic solid dielectric material with cubic symmetry.	08	L2	CO2
	c.	Explain construction and working of a DC-SQUID.	05	L2	CO2
		Module – 3			
Q.5	a.	Explain the various phenomena when radiation interacts with matter and derive an expression for energy density of radiation under thermal equilibrium condition, in terms of Einstein's coefficients.	10	L2	CO1
	b.	Discuss the different types of optical fibers with suitable diagrams.	06	L2	CO1
	c.	The ratio of population of two energy levels in a laser material at 57°C is 0.944×10^{30}. Find the wavelength of the light emitted by spontaneous emissions.	04	L3	CO1

		OR			
Q.6	**a.**	Describe the construction and working of CO_2 laser with the help of necessary diagrams.	**10**	**L2**	**CO1**
	b.	Derive an expression for numerical aperture in an optical fiber with a neat diagram.	**06**	**L2**	**CO1**
	c.	The attenuation in an optical fiber is 2.2 dB/km . What fraction of its initial light intensity remains after 2 km length?	**04**	**L3**	**CO1**
		Module – 4			
Q.7	**a.**	State and derive Gauss's divergence theorem.	**08**	**L2**	**CO3**
	b.	Derive the electromagnetic wave equation using Maxwell's equations.	**08**	**L2**	**CO3**
	c.	A vector field is given $\vec{F} = 2x^3i + 5y^2j + 9zk$. Find the divergence of $\vec{F}$ at (1, 2, 3).	**04**	**L3**	**CO3**
		OR			
Q.8	**a.**	Write the four Maxwell's equations for time-varying conditions in vacuum and explain each notations used in it.	**08**	**L2**	**CO3**
	b.	What is displacement current density? Derive an expression for displacement current.	**08**	**L2**	**CO3**
	c.	Show that given vector field $\vec{A}$ is irrotational. Given $\vec{A} = (3x^2 + y + 2z)i + (x - 5y^3 - 2z)j + (2x - 2y + 3z^2)k$	**04**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	State law of mass action in semiconductors. Derive an expression for electrical conductivity of an intrinsic semiconductor.	**08**	**L2**	**CO4**
	b.	Describe four Probe method to determine the resistivity of a thin semiconductor sample.	**08**	**L2**	**CO4**
	c.	In the experiment of dielectric constant of the material of capacitor, the intersecting time interval for charging and discharging (T_p) is found to be 7 sec with a resistor of 110 kΩ. Find the area of the capacitor plate "A". Given that thickness of dielectric material and dielectric constant are 1.02mm and 4.2 respectively.	**04**	**L3**	**CO5**
		OR			
Q.10	**a.**	What is hall effect? Derive an expression for Hall-coefficient with necessary diagrams.	**08**	**L2**	**CO4**
	b.	What is direct band gap semiconductor? Explain the construction and working of a GaAs laser.	**08**	**L2**	**CO4**
	c.	The electrical conductivity of a intrinsic semiconductor with carrier density $2.37 \times 10^{19}/m^3$ at 300 K is 2.12 $\Omega^{-1}m^{-1}$. Assuming electron mobility as 0.38 $m^2V^{-1}s^{-1}$, calculate mobility of holes.	**04**	**L3**	**CO4**

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