CBCS SCHEME

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BPHYE102/202

First/Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.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. *VTU Formula Hand Book is permitted.*
3. *M : Marks , L: Bloom's level , C: Course outcomes.*
4. *Speed of light $c = 3 \times 10^8$ m/s, $K = 1.38 \times 10^{-23}$ J/K, $h = 6.625 \times 10^{-34}$ JS, $g = 9.8$ m/s^2, $\epsilon_0 = 8.854 \times 10^{-12}$ F/m*

		Module – 1	M	L	C
Q.1	a.	State and explain Heisenberg's uncertainty principle and show that there is no existence of electrons in the nucleus of an atom.	9	L2	CO1
	b.	What is a wave function, probability density and normalization of wave function?	7	L2	CO1
	c.	Find the lowest energy of an electron confined to move in a one dimensional potential box of length 1A in electron volts.	4	L3	CO1
		OR			
Q.2	a.	Setup time Independent Schrodinger's wave equation for a particle in one dimension.	7	L2	CO1
	b.	Discuss the wave functions, probability densities and energy for a particle in a box by considering the ground state and first two excited states.	9	L2	CO1
	c.	Calculate the de-Broglie wavelength of an electron when it is accelerated to a potential of 5000 V.	4	L3	CO1
		Module – 2			
Q.3	a.	Mention any three assumptions of quantum free electron theory. Discuss the variation of Fermi factor with temperature and energy.	9	L2	CO1
	b.	Explain the construction and working of MAGLEV vehicle.	6	L2	CO1
	c.	An elemental solid dielectric material has polarizability of 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	CO1
		OR			
Q.4	a.	What is super conductivity? Describe Type-I and Type-II superconductors.	7	L2	CO1
	b.	What is dielectric polarization? Explain various types of polarization mechanism.	8	L2	CO1
	c.	Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K in a material.	5	L3	CO1
		Module – 3			
Q.5	a.	Obtain an expression for energy density of radiation under thermal equilibrium conditions in terms of Einstein's coefficients.	8	L2	CO2
	b.	What is attenuation? Explain different types of attenuation in optical fibers.	8	L2	CO2
	c.	The average output power of laser source emitting a laser beam of wave length 6328 A is 5 mW. Find the number of photons emitted per second by the laser source.	4	L3	CO2
		OR			

Q.6	a.	What is numerical aperture? Obtain an expression for numerical aperture interms of refractive indices of core and cladding of an optical fiber.	9	L2	CO2
	b.	Describe the working of a laser printer.	6	L2	CO2
	c.	The attenuation of light in an optical fiber is estimated at 2.2 dB/km. What fractional initial intensity remains after 2 km and after 6 km.	5	L3	CO2
		Module – 4			
Q.7	a.	State and prove Gauss Divergence theorem.	7	L2	CO3
	b.	Explain Faraday's laws of electromagnetic induction and amperes law. Express the same in point form.	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
		OR			
Q.8	a.	Derive wave equation in terms of electric field using Maxwell's equations for free space.	8	L2	CO3
	b.	Discuss continuity equation. Derive the expression for displacement current.	8	L2	CO3
	c.	Calculate the curl of $\vec{A}$ given by $\vec{A} = (1 + yz^2)\hat{a}_x + xy^2\hat{a}_y + x^2y\hat{a}_z$.	4	L3	CO3
		Module – 5			
Q.9	a.	Derive an expression for electrical conductivity in extrinsic and intrinsic semiconductors.	8	L2	CO4
	b.	Describe the construction and working of semiconductor laser with energy level diagram.	8	L2	CO4
	c.	The Hall coefficient of a specimen of a doped silicon is found to be 3.66×10^{-4} m^3/c. The resistivity of the specimen is 9.93×10^{-3} ohm-m. Find the mobility and charge carrier density assuming single carrier conduction.	4	L3	CO4
		OR			
Q.10	a.	Explain Fermi level in an intrinsic semiconductor and derive the relation between Fermi energy and energy gap for an intrinsic semiconductor.	9	L2	CO4
	b.	Explain construction and working of photo diode.	7	L2	CO5
	c.	The resistivity of intrinsic germanium at 27°C is 0.47 ohm-meter. If the electron and hole mobilities are 0.38 m^2/VS and 0.18 m^2/VS respectively. Calculate the intrinsic carrier density.	4	L3	CO4

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