U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: I / II**
Branch: Computer Science stream **Duration: 3 hrs.**
Course Code: 22PH1BSPCS / 22PH2BSPCS **Max Marks: 100**
Course: Applied Physics for Computer Science Stream

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Physical constants:

Mass of electron, $m_e = 9.1\times10^{-31}$ kg
Electronic charge, $e = 1.602\times10^{-19}$ C
Boltzmann constant, $k_B = 1.38\times10^{-23}$ J/K
Permittivity of free space$=8.85\times10^{-12}$ F/m
Speed of light, $c = 3\times10^{8}$ m/s
Planck constant, $h = 6.626\times10^{-34}$ Js
Mass of neutron, $m_n = 1.67\times10^{-27}$ kg
Mass of proton, $m_p = 1.67\times10^{-27}$ kg

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		Module - I	CO	PO	Marks
1	a)	Mention the characteristics of LASER. Describe the construction and working of semiconductor laser with a neat schematic and energy level diagram.	CO1	PO 1	**8**
	b)	What is numerical aperture? Derive an expression for the numerical aperture of an optical fiber.	CO1	PO1	**8**
	c)	In a LASER system, the energy difference between two energy levels is 2×10^{-19} joules. The average output power of a LASER beam is found to be 4 mW. Calculate the number of photons emitted per second.	CO1	PO2	**4**
		OR			
2	a)	Derive an expression for the energy density of radiation under equilibrium conditions in terms of Einstein's coefficients.	CO1	PO1	**8**
	b)	Define attenuation coefficient. Discuss various mechanisms responsible for power loss in optical fiber.	CO1	PO1	**8**
	c)	Calculate the V-number for a fiber of core diameter 40 μm and refractive indices of 1.55 and 1.50, respectively for core and cladding when the wavelength of the propagating wave is 1400 nm. Also, calculate the number of modes that the fiber can support for propagation. Assume that the fiber is in the air.	CO1	PO2	**4**
		Module - II			
3	a)	Define phase velocity and group velocity. Obtain the relation between them in a dispersive medium.	CO1	PO1	**8**
	b)	Explain probability density of a wave function. Set up one dimensional time independent Schrodinger's wave equation.	CO1	PO1	**8**

		c)	Calculate the momentum of an electron and the de Broglie wavelength associated with it, if its kinetic energy is 1.5 keV.	*CO1*	*PO2*	**4**
			OR			
	4	a)	State Heisenberg's uncertainty principle and explain why the electron does not exist inside the nucleus using this principle.	*CO1*	*PO1*	**8**
		b)	Using Schrodinger's wave equation, arrive at Eigen value and normalized wave function for a particle confined to one dimensional infinite height potential well.	*CO1*	*PO1*	**8**
		c)	An electron is bound in a one-dimensional potential well of width 1 Å and infinite wall height. Find energy values in the ground state and first excited state.	*CO1*	*PO2*	**4**
			Module - III			
	5	a)	Mention the postulates of Quantum Free Electron Theory (QFET). Discuss any two merits of QFET.	*CO1*	*PO1*	**8**
		b)	What is polarization in dielectrics? Describe the different polarization mechanisms with neat schematic diagram.	*CO1*	*PO1*	**8**
		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.	*CO1*	*PO2*	**4**
			Module - IV			
	6	a)	Derive an expression for the electrical conductivity of an intrinsic semiconductor and hence arrive at the relation for energy band gap.	*CO1*	*PO1*	**8**
		b)	What is superconductivity? Explain in detail type-I and type-II superconductors with M-H curve and examples.	*CO1*	*PO1*	**8**
		c)	The Hall coefficient of a material is -3.68×10^{-5} m^3/C. What are the types of charge carriers? Also, calculate the carrier concentration.	*CO1*	*PO2*	**4**
			Module - V			
	7	a)	What is Qubit? Mention its properties. Elucidate the differences between classical and quantum computing.	*CO1*	*PO1*	**8**
		b)	Mention different types of multiple qubit gates. Explain the operation of CNOT gate (Controlled Not Gate) on four different input states. Draw the circuit diagram and truth table.	*CO1*	*PO1*	**8**
		c)	Find the inner product of $\|U\rangle = \begin{pmatrix} 3+i \\ 4-i \end{pmatrix}$ and $\|V\rangle = \begin{pmatrix} 3i \\ 4 \end{pmatrix}$	*CO1*	*PO2*	**4**

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