U.S.N.										

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

Autonomous Institute Affiliated to VTU

September 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)	Discuss the general conditions for laser action. Explain the construction and working of semiconductor laser with suitable diagram.	CO1	PO1	8
	b)	Define attenuation. Discuss the causes of signal attenuation in an optical fiber.	CO1	PO1	8
	c)	The ratio of population of two energy levels is 2.2 x 10^{-30}. Find the wavelength of light emitted by spontaneous emission at 300 K.	CO1	PO2	4
		OR			
2	a)	Define numerical aperture. Show that the light gathering capacity of an optical fiber is equal to $\sqrt{n_1^2 - n_2^2}$, where the terms have their usual meaning.	CO1	PO1	8
	b)	If A and B are Einstein coefficients, then show that $B_{21} = B_{12}$ where the notations have their usual meaning	CO1	PO1	8
	c)	An optical fiber is immersed in an oil bath of RI 1.06. If the numerical aperture of the fiber is 0.39 and if the difference in RIs of the material of its core and the cladding is 0.05, calculate the RI of the material of the core.	CO1	PO2	4
		Module - II			
3	a)	Define group velocity. Deduce the relation of group velocity and particle velocity.	CO1	PO1	8
	b)	Starting from the normalized wave function for a particle confined in a 1-D potential well, discuss the wave function, probability density and energy Eigen values for the ground and the first excited states.	CO1	PO1	8

		c)	A particle of mass 0.55 MeV/c^2 has a kinetic energy of 70 eV. Calculate the de-Broglie wavelength and group velocity of the wave.	***CO1***	***PO2***	**4**
			OR			
	4	a)	Discuss the physical significance of Heisenberg's uncertainty principle. Also prove the non-existence of electron within the nucleus of an atom.	***CO1***	***PO1***	**8**
		b)	Mention any two properties of wave function and setup the expression for 1-D time independent Schrodinger wave equation.	***CO1***	***PO1***	**8**
		c)	Compare the de Broglie wavelengths of electron and neutron moving with one tenth of the velocity of light.	***CO1***	***PO2***	**4**
			Module - III			
	5	a)	Define Fermi factor and Fermi energy. Discuss Fermi factor for the cases $E<E_F$, $E>E_F$ and $E=E_F$ at T= 0 K with neat illustration.	***CO1***	***PO1***	**8**
		b)	Discuss electronic polarization. Deduce an expression for electronic polarizability exhibited by a pure elemental dielectric material.	***CO1***	***PO1***	**8**
		c)	Calculate the Fermi energy of sodium assuming that the metal has one free electron per atom. Given the density of sodium = 970 kg/m^3 and atomic weight of sodium = 22.99.	***CO1***	***PO2***	**4**
			Module - IV			
	6	a)	Discuss the phenomenon of Hall effect in a semiconductor with neat sketch and hence deduce an expression for Hall potential in terms of Hall coefficient.	***CO1***	***PO1***	**8**
		b)	Write a note on BCS theory in superconductors. Discuss the application of superconductors in Maglev vehicle with a neat sketch.	***CO1***	***PO1***	**8**
		c)	Calculate the critical current for a wire of lead having a diameter of 1 mm at 5.2 K. Critical temperature for lead is 8.18 K and H_0 = 6.5 X 10^4 Am^{-1}	***CO1***	***PO2***	**4**
			Module - V			
	7	a)	Explain Moore's law and its end. List out the differences between classical and quantum computing.	***CO1***	***PO1***	**8**
		b)	Write the truth table, circuit diagram and matrices for controlled Toffoli gate and Hadamard gate	***CO1***	***PO1***	**8**
		c)	Using matrix multiplication show that applying Hadmard gate twice to l0> results in its original gate.	***CO1***	***PO2***	**4**

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