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

Autonomous Institute Affiliated to VTU

April 2023 Semester End Main Examinations

Programme: B.E.   Semester: I
Branch: ISE/AIML/CSDS/BT   Duration: 3 hrs.
Course Code: 22PH1BSPCS   Max Marks: 100
Course: Applied Physics for Computer Science Stream   Date: 08.04.2023

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

Physical constants:

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg   Speed of light, $c = 3 \times 10^8$ m/s
Electronic charge, $e = 1.602 \times 10^{-19}$ C   Planck constant, $h = 6.626 \times 10^{-34}$ Js
Boltzmann constant, $k_B = 1.38 \times 10^{-23}$ J/K   Mass of neutron, $m_n = 1.67 \times 10^{-27}$ kg
Permittivity of free space $= 8.85 \times 10^{-12}$ F/m   Mass of proton, $m_p = 1.67 \times 10^{-27}$ kg

Module-I

1	a)	Derive an expression for energy density at thermal equilibrium in terms of Einstein's coefficients.	**08**
	b)	Mention the characteristics of LASER. Explain the working of the LASER barcode reader with neat sketch.	**08**
	c)	The average output power of a LASER beam of wavelength 650 nm is 10 mw. Find the number of photons emitted per second by the LASER source.	**04**

OR

2	a)	Discuss the point-to-point fiber optic communication system. Mention any four advantages of optical fiber communication over the conventional communication system.	**08**
	b)	Discuss the different types of optical fibers with a neat diagram.	**08**
	c)	Optical fiber has a core of R.I. 1.5 and R.I. of cladding is 3% less than the core index. Calculate the numerical aperture and angle of acceptance.	**04**

Module-II

3	a)	Define phase velocity and group velocity and obtain the relation between them.	**08**
	b)	State Heisenberg's uncertainty principle and show that an electron does not exist inside the nucleus by this principle.	**08**
	c)	A quantum particle is confined to a one-dimensional potential well of width 'a' in its first excited state. What is the probability of finding the particle over an interval of 'a/2' marked symmetrically at the center of the well?	**04**

OR

4 a) Set up a time-independent Schrodinger's wave equation for a particle moving along x- direction. **08**

   b) Apply Schrodinger's wave equation to a particle confined to one dimensional potential well of infinite height and hence obtain the expressions for Eigen values and Eigen functions. **08**

   c) Calculate the momentum and de Broglie wavelength of an electron having a kinetic energy of 1.5 Kev. **04**

Module-III

5 a) Define Fermi energy and Fermi factor. Discuss the variation of the Fermi factor with temperature and energy. **08**

   b) What are dielectrics? Arrive at an expression for internal field in the case of liquid and solid dielectrics. **08**

   c) An elemental solid dielectric material has a 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. **04**

Module-IV

6 a) Derive an expression for the electrical conductivity of an intrinsic semiconductor. **08**

   b) Explain Meissner effect and hence classify superconductors into soft and hard superconductors by using M-H graphs. **08**

   c) The Hall coefficient of a specimen of doped silicon is found to be 3.66×10^{-4} m^3 /**c**. The resistivity of the specimen is 8.93×10^{-3} Ωm. Find the mobility and density of the charge carrier, assuming single carrier conduction. **04**

Module-V

7 a) Explain Moore's law. Elucidate the difference between classical and quantum computing. **08**

   b) Describe the working of quantum NOT Gate, mentioning its matrix representation, circuit, and truth table. Apply Pauli matrices on the states I0> and I1>. **08**

   c) A linear operator X operates such that X I0> =I1> and XI1>=I0>. Find the matrix representation of X. **04**

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