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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: ECE/EEE **Duration: 3 hrs.**
Course Code: 22PH1BSPEE **Max Marks: 100**
Course: Applied Physics for Electrical Engineering 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
Electronic charge, $e = 1.602 \times 10^{-19}$ C
Boltzmann constant, $k_B = 1.38 \times 10^{-23}$ J/K
Permittivity of free space$= 8.85 \times 10^{-12}$ F/m
Speed of light, $c = 3 \times 10^{8}$ m/s
Planck constant, $h = 6.626 \times 10^{-34}$ Js
Mass of neutron, $m_n = 1.67 \times 10^{-27}$ kg
Mass of proton, $m_p = 1.67 \times 10^{-27}$ kg

Module-I

1	a)	Explain the hypothesis of de-Broglie. Deduce the relationship connecting group velocity and particle velocity.	**08**
	b)	Apply Schrodinger's wave equation to a one dimensional infinitely deep potential well and solve it to find its normalized wave function.	**08**
	c)	Calculate the error in wavelength of a spectral line associated with an energy state of life time 1×10^{-8} s, when the transition from this state results in a spectral line of wavelength 4×10^{-7} m.	**04**

OR

2	a)	What are the properties of a wave function? Set up the Schrodinger's one-dimensional time independent equation for a moving quantum mechanical particle.	**08**
	b)	State Heisenberg's Uncertainty principle. Apply it to show that an electron cannot reside inside the nucleus of an atom.	**08**
	c)	Compute the ratio of the kinetic energies of a photon of wavelength 0.1 nm and a proton wave of the same wavelength.	**04**

Module-II

3	a)	Describe the construction of He-Ne gas LASER with a schematic representation and its working with an energy level diagram.	**08**
	b)	What is attenuation? Explain the various mechanisms of attenuation in optical fibers.	**08**

c) Calculate the fractional refractive index change and V-number for an optical fiber of diameter 40 μm with refractive indices of the core and cladding 1.55 and 1.5 respectively, if the wavelength of propagation through it is 1.400×10^{-7}m. **04**

OR

4 a) Starting from the three transition rate equations, obtain the relation between the three Einstein's coefficients, at thermal equilibrium. Also deduce the conditions for LASER action. **08**

b) What are the types of optical fibers? Describe the ray propagation through them. **08**

c) The ratio of population of two energy levels is 1.06×10^{-30}. Find the frequency and wavelength of light emitted at 27°C. **04**

Module-III

5 a) Explain the four types of polarization mechanisms in dielectrics, with neat sketches. **08**

b) What do you understand by the terms Fermi energy and Fermi factor? Explain with a suitable graph, the variation of Fermi factor with temperature. **08**

c) What are the energies for which the probabilities of occupation at 300 K are (i) 0.99 and (ii)0.01 for silver with Fermi energy 5.5eV? **04**

Module-IV

6 a) Describe the Four probes method to determine the energy gap and resistivity of a semiconductor. **08**

b) Derive an expression for the number of electrons per unit volume in the conduction band of a semiconductor, assuming the density of energy states in it. **08**

c) The conductivity and Hall coefficient of an n-type silicon specimen are $112/\Omega$-m and 1.25×10^{-3}/C respectively. Calculate the charge carrier concentration and electron mobility, **04**

Module-V

7 a) Describe with a suitable graph, Soft and Hard magnetic materials. **08**

b) Describe with a suitable graph, the two types of superconductors. **08**

c) Calculate the critical field at 7 K and critical current for a superconducting material of thickness 1 mm, given that its transition temperature is 7.18 K and critical magnetic field at 0K is 65000 A/m. **04**

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