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

**Autonomous Institute Affiliated to VTU**

## August 2023 Semester End Make-Up 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: 16.08.2023**

**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

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|---|---|---|---|
| 1 | a) | Define Phase velocity and Group velocity. Derive the relation between Phase velocity and Group velocity. | **08** |
| | b) | Explain properties of wave function. Setup time independent one dimensional Schrodinger wave equation. | **08** |
| | c) | An electron is bound in a one-dimensional potential well of width 1Å, but of infinite wall height. Find its energy values in ground state and first excited state. | **04** |

**OR**

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|---|---|---|---|
| 2 | a) | Using Schrodinger wave equation, derive a normalized eigen function for the particle in one dimensional potential wall of infinite height by applying boundary Conditions. | **08** |
| | b) | State Heisenberg's uncertainty principle. Using Heisenberg's uncertainty principle prove that free electron does not exist inside the nucleus | **08** |
| | c) | In a measurement of position and momentum that involved an uncertainty of 0.003%, the speed of the electron was found to be 800 m/s. Calculate the corresponding uncertainty that arises in determining its position. | **04** |

### Module-II

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|---|---|---|---|
| 3 | a) | Derive an expression for energy density of radiation under thermal equilibrium conditions in terms of Einstein's Co-efficient. | **08** |
| | b) | Define numerical aperture. Derive an expression for numerical aperture of an optical fiber. | **08** |

c) The numerical aperture of an optical fiber is 0.2 when surrounded by air. Determine the refractive index of its core, given the refractive index of the cladding is 1.59. Also find the acceptance angle when the fiber is in water. Assume the refractive index of water as 1.33. **04**

**OR**

4 a) Describe the construction and working of He-Ne LASER with energy level diagram. **08**

b) Describe point to point communication system using optical fiber with the help of block diagram and mention its advantages over the conventional communication system. **08**

c) The ratio of population of two energy levels is $1.059 \times 10^{-30}$. Find the frequency and wavelength of light emitted at 330 K. **04**

**Module-III**

5 a) What is Fermi energy? Explain Fermi factor and its dependence on energy and temperature. **08**

b) Explain the Four types of polarization mechanism in dielectrics with suitable Illustrations. **08**

c) An elemental solid dielectric material has polarizability $7 \times 10^{-40}$ $Fm^2$. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the material if the material has $3 \times 10^{28}$ atoms/$m^3$ **04**

**Module-IV**

6 a) Derive an expression for electron concentration in conduction band of a semiconductor. **08**

b) What is Hall Effect? Derive an expression for Hall voltage and Hall co-efficient. **08**

c) The Hall co-efficient of a material is $-3.68 \times 10^5$ $m^3/C$. What is the type of charge carriers? Also calculate carrier concentration. **04**

**Module-V**

7 a) Explain the Weiss's domain theory of ferromagnetic materials and explain in brief the hysteresis using the domain theory. **08**

b) Explain Meissner effect. Describe type I and type II superconductors. **08**

c) Explain the application of superconductivity in MAGLEV vehicle. **04**

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