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

**Autonomous Institute Affiliated to VTU**

## October 2024 Supplementary Examinations

**Programme: B.E.** **Semester: I / II**

**Branch: ELECTRICAL STREAM** **Duration: 3 hrs.**

**Course Code: 22PH1BSPEE / 22PH2BSPEE** **Max Marks: 100**

**Course: APPLIED PHYSICS FOR ELECTRICAL 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) | Define phase velocity and group velocity. Deduce the relation between group velocity and particle velocity. | CO1 | PO1 | **8** |
| | b) | Setup one dimensional time independent Schrodinger's wave equation. | CO1 | PO1 | **8** |
| | c) | A particle of mass 0.5 MeV/$C^2$ has a kinetic energy of 100 eV. Find the de-Broglie wavelength and group velocity of the de Broglie wave. | CO1 | PO2 | **4** |
| | | **OR** | | | |
| 2 | a) | State and explain Heisenberg's uncertainty principle. Using this principle show that an electron cannot exist within the nucleus of an atom. | CO1 | PO1 | **8** |
| | b) | Mention the properties of the wave function. Discuss the Eigen function, Eigen value and probability density for the first two energy states of a particle inside a one-dimensional potential well of infinite height and finite width. | CO1 | PO1 | **8** |
| | c) | The position and momentum of 1 keV electron are simultaneously determined and if its position is located with in 1 Å. What is the percentage of uncertainty in its momentum? | CO1 | PO2 | **4** |
| | | **Module - II** | | | |
| 3 | a) | Derive an expression for the energy density of radiation under equilibrium conditions in terms of Einstein's coefficients. | CO1 | PO1 | **8** |
| | b) | Discuss the construction and working of the He-Ne laser with an energy level diagram. | CO1 | PO1 | **8** |
| | c) | The radiation of wavelength 1.5 μm is emitted at 350 K for a system. Calculate the (i) ratio of Einstein coefficients and | CO1 | PO2 | **4** |

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| | | | (ii) ratio of rate of stimulated emission to spontaneous emission. | | | |
| | | | **OR** | | | |
| | 4 | a) | What is numerical aperture? Derive an expression for the numerical aperture of an optical fiber and then arrive at the condition for light propagation. | *CO1* | *PO1* | **8** |
| | | b) | Discuss briefly the classification of optical fibers with suitable diagrams. | *CO1* | *PO1* | **8** |
| | | c) | A 750 m long optical fibre has an input power of 90 mW and an output power of 80 mW. Calculate the signal attenuation coefficient. | *CO1* | *PO2* | **4** |
| | | | **Module - III** | | | |
| | 5 | a) | Mention the postulates of quantum free electron theory. Describe any two major successes of quantum free electron theory. | *CO1* | *PO1* | **8** |
| | | b) | Define electronic polarization. Obtain an expression for electronic polarizability of a dielectric material. | *CO1* | *PO1* | **8** |
| | | c) | Calculate the probability of an electron occupying an energy level 0.02 eV above and below the Fermi level at 200 K. | *CO1* | *PO2* | **4** |
| | | | **Module - IV** | | | |
| | 6 | a) | With neat band diagrams, discuss the Fermi levels in intrinsic and extrinsic semiconductors. Also show that the Fermi level in intrinsic semiconductors is exactly lies between the valence band and conduction band. | *CO1* | *PO1* | **8** |
| | | b) | With suitable diagram, explain the phenomenon of Hall Effect in semiconductors. Obtain an expression for Hall voltage and Hall coefficient. | *CO1* | *PO1* | **8** |
| | | c) | The resistivity of intrinsic silicon at 300 K is 3000 $\Omega m$. Assuming electron and hole mobilities as 0.17 $m^2/V.s$ and 0.035 $m^2/V.s$ respectively, calculate the intrinsic carrier concentration. | *CO1* | *PO2* | **4** |
| | | | **Module - V** | | | |
| | 7 | a) | Describe Weiss's theory of magnetic domains. Explain magnetic hysteresis on the basis of domain theory. | *CO1* | *PO1* | **8** |
| | | b) | What is Meissner effect? Discuss BCS theory of superconductivity. | *CO1* | *PO1* | **8** |
| | | c) | Calculate the critical current for a wire of lead having a diameter of 1 mm at 5.2 K. Given critical temperature for lead is 8.18 K and $H_0 = 6.5 \times 10^4$ $Am^{-1}$. | *CO1* | *PO2* | **4** |



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