***U.S.N*** | | | | | | | | | | |

# P.E.S. College of Engineering, Mandya - 571 401

***(An Autonomous Institution affiliated to VTU, Belagavi)***

## First Semester, B.E. - Semester End Examination; May - 2022

## Engineering Physics

(Common to All Branches)

*Time: 3 hrs* *Max. Marks: 100*

***Course Outcomes***

*The Students will be able to:*

*CO1: Recall the fundamental Definitions or Laws of physics relevant to Engineering field.*

*CO2: Mention the various Properties and Applications by understanding the course topics pertaining to Engineering field.*

*CO3: Explain various Concepts and Principles used in the topics to understand the theory related to Engineering field.*

*CO4: Derive the expressions for the Physical Quantities on the topics of the course by applying the theory relevant to Engineering field.*

*CO5: Solve the numerical problems by applying proper solutions to verify the theoretical concepts related to Engineering field.*

***Note:*** ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

***II) PART - B****: Answer any* ***Two*** *sub questions (from a, b, c) for a Maximum of* ***18 marks*** *from each unit.*

***Physical constants:*** *Electron mass, $m = 9.11x10^{-31}$ kg, Electron charge, $e = 1.602x10^{-19}$ C; Velocity of light, $c = 3x10^{8}$ $ms^{-1}$; Planck's constant, $h = 6.626x10^{-34}$ Js; Boltzmann constant, $K = 1.38x10^{-23}$ $JK^{-1}$; Avogadro number, $N = 6.025x10^{23}$/mole; Permittivity of free space, $\varepsilon_o = 8.85x10^{-12}$ $Fm^{-1}$.*

| Q. No. | | Questions | Marks | BLs | COs | POs |
|---|---|---|---|---|---|---|
| | | **I : PART - A** | **10** | | | |
| I | a. | State Heisenberg's uncertainty principle with expression. | 2 | L1 | CO1 | PO1 |
| | b. | Mention four types of Polarization. | 2 | L1 | CO2 | PO1 |
| | c. | Write an expression for electron concentration in conduction band. | 2 | L1 | CO1 | PO1 |
| | d. | What is laser cavity? | 2 | L1 | CO1 | PO1 |
| | e. | Define Mach number and Mach angle. | 2 | L1 | CO1 | PO1 |
| | | **II : PART - B** | **90** | | | |
| | | **UNIT - I** | **18** | | | |
| 1 | a. | What are matter waves? Derive the expression for de-Broglie wavelength using group velocity. | 9 | L1 | CO1 | PO1 |
| | b. | Derive the expression for Eigen function and Eigen energy for a particle in a potential well of infinite height. | 9 | L3 | CO4 | PO1 |
| | c. | i) While measuring velocity 0.8 km/s of an electron, the experiment involves an error of 0.003%. What could be the corresponding uncertainty in the measurement of position? | 4 | L3 | CO5 | PO2 |
| | | ii) An electron is trapped in a 1-D potential well of infinite height and of width of 0.1 nm. Calculate the energy required to excite it from its ground state to fifth excited state. | 5 | L3 | CO5 | PO2 |
| | | **UNIT - II** | **18** | | | |
| 2 | a. | Derive the relation between Young's modulus, Bulk modulus, Rigidity modulus and Poisson's ratio. | 9 | L3 | CO4 | PO1 |

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|---|---|---|---|---|---|
| b. | i) Define dielectric constant and dielectric polarization. Explain the applications of dielectrics in transformers. | 6 | L1 | CO1 | PO1 |
| | ii) Find the polarization produced in a dielectric medium of relative permittivity 15 in presence of an electric field of 500 *V/m*. | 3 | L1 | CO1 | PO1 |
| c. | Write a note BCS theory of super conductivity and Maglev vehicles. | 9 | L2 | CO3 | PO1 |
| | **UNIT - III** | **18** | | | |
| 3 a. | Define the terms Fermi velocity and Fermi temperature. Discuss the variation of Fermi factor with energy and temperature. | 9 | L1 | CO1 | PO1 |
| b. | Derive the expression for conductivity and resistivity of an intrinsic semiconductor in terms of mobility of charge carriers. | 9 | L3 | CO4 | PO1 |
| c. | i) Explain the merits of quantum free electron theory. | 5 | L3 | CO5 | PO2 |
| | ii) For intrinsic gallium arsenide, at room temperature electrical conductivity is $10^{-6}\Omega^{-1}m^{-1}$, the electron and hole mobilities are $0.85\,m^2v^{-1}s^{-1}$ and $0.04\,m^2v^{-1}s^{-1}$ respectively. Compute the intrinsic carrier concentration at room temperature. | 4 | L3 | CO5 | PO2 |
| | **UNIT - IV** | **18** | | | |
| 4 a. | Derive the expression for energy density in terms of Einstein's coefficients. | 9 | L3 | CO5 | PO2 |
| b. | Discuss the tree types of optical fibers with neat diagram. | 9 | L3 | CO5 | PO2 |
| c. | i) A pulsed laser emits photons of wavelength 780 *nm* with 20 *mW* average powers per pulse. Calculate the number of photons contained in each pulse if the pulse duration is 10 *ns*. | 4 | L3 | CO5 | PO2 |
| | ii) The attenuation of light in an optical fiber is estimated to be 2.0 *dB/km*. What friction of the initial intensity remains after 1 km and after 8 km. | 5 | L3 | CO5 | PO2 |
| | **UNIT - V** | **18** | | | |
| 5 a. | Define reverberation time. Describe the factors affecting a good acoustical building and their remedies. | 9 | L2 | CO3 | PO1 |
| b. | i) Explain the measurement of ultrasonic velocity in liquids. | 5 | L2 | CO3 | PO1 |
| | ii) A cinema hall has a volume of 7500 $m^3$. It is required to have reverberation time of 1.5 seconds. What should be the total absorption in the hall? | 4 | L2 | CO3 | PO1 |
| c. | i) Mention the applications of shock waves. | 5 | L3 | CO5 | PO2 |
| | ii) The distance between the two pressure sensors in a shock tube is 150 mm. The time taken by a shock wave to travel this distance is 0.3 ns. If the velocity of sound under the same condition is 340 $ms^{-1}$, find the Mach number of the shock wave. | 4 | L3 | CO5 | PO2 |

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