

PHYSICS - II (Optional)

*Standard : Degree**Total Marks : 200**Nature : Conventional**Duration : 3 Hours***Note :**

- (i) *Answers must be written in English.*
- (ii) *Question No. 1 is Compulsory. Of the remaining questions, attempt **any four** selecting one question from each section.*
- (iii) *Figures to the **RIGHT** indicate marks of the respective question.*
- (iv) *Make suitable assumptions, wherever be necessary and state the same.*
- (v) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*
- (vi) *Credit will be given for orderly, concise and effective writing.*
- (vii) *Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.*
- (viii) *For each slab of 10 and 15 marks, the examinee is expected to write answers in 125 and 200 words respectively.*

1. Answer any four of the following :**40**

- (a) Show that the potential due to a polarized object at a point outside it is the sum of the potential due to a surface charge density σ_b and that due to a volume charge density ρ_b .
- (b) Derive Plank's radiation formula.
- (c) Describe a He-Ne Laser and explain its working.
- (d) Write a note on Global Positioning Satellite (GPS) System.
- (e) What do you understand by remote sensing ? Write briefly about Indian remote sensing satellites.

SECTION - A**2. Answer the following sub-questions :**

- (a) Obtain the Poisson's and Laplace's equation in Electrostatics. Give the solution of Laplace's equation in one dimension. **10**

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| (b) | (i) Apply Biot and Savart's Law to find the force between two long straight parallel current carrying conductors. | 10 |
| | (ii) What is meant by series resonance and parallel resonance ? | 5 |
| (c) | Obtain the differential form of Poynting's theorem. Compare it with the equation of continuity expressing the conservation of charge. | 15 |
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| 3. | <i>Answer the following sub-questions :</i> | |
| (a) | Consider a charge +q placed a distance d above an infinite conducting plane that is earthed. Find the electrostatic potential and the electrostatic field near the plane. | 10 |
| (b) | Give the theory of an ideal transformer. What are step-up and step-down transformer ? | 15 |
| (c) | State Maxwells equations for electric and magnetic fields and explain their significance. | 15 |

SECTION - B

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| 4. | <i>Answer the following sub-questions :</i> | |
| (a) | State and prove Heisenberg's Uncertainty Principle. | 10 |
| (b) | Set up the Schrodinger's time dependent wave equation by analogy with classical wave equation. | 15 |
| (c) | (i) Write a note on Interpretation of the quantum number. | 8 |
| | (ii) By applying Schrodingers time independent wave equation for hydrogen atom. Find the energy of the atom in the ground state. | 7 |
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| 5. | <i>Answer the following sub-questions :</i> | |
| (a) | Discuss the nature of De Broglie wave associated with a particle in motion. Obtain an expression for the De Broglie wavelength associated with a particle of mass m moving with the velocity v . | 10 |
| (b) | What are operators ? What is their role in wave mechanics ? Write down the operators for energy and momentum and Schrodinger's wave equation may be deduced from these operators. | 15 |
| (c) | Write the time independent Schrodinger wave equation for the hydrogen atom in spherical polar coordinates and separate it into three differential equations for the three parts of the total wave function. | 15 |

SECTION - C

6. *Answer the following sub-questions :*

- (a) Describe the Stern-Gerlach experiment to demonstrate the space quantization of angular momentum of an atom. **10**
- (b) What is Raman effect ? Explain the Raman effect on the basis of the classical theory. **10**
- (c) Explain the terms : **10**
- (i) Mass defect
- (ii) Binding Energy of the nucleus
- (d) What is the Geiger Nuttal Law ? Explain its importance in alpha decay. **10**

7. *Answer the following sub-questions :*

- (a) Explain the terms : **10**
- (i) Pauli's exclusion principle
- (ii) LS Coupling
- (b) State the Franck-Condon Principle and explain the origin of electronic spectra. **10**
- (c) Explain the main characteristics of nuclear forces. **10**
- (d) What is Beta-decay ? Explain the salient features of the β spectrum. **10**

SECTION - D

8. *Answer the following sub-questions :*

- (a) (i) Give a brief account of metals, insulators and semiconductors on the basis of the bond theory of solids. **9**
- (ii) Write a note on the ferromagnetic domain. **6**

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| (b) Write a note on the p-type and n-type semiconductors. | 10 |
| (c) (i) What is CE configuration of a transistor ? Explain static characteristics of a transistor in CE mode. How will you determine the input resistance at a given point from this curve. | 10 |
| (ii) For a transistor in CE mode the beta factor is 400. Find the alpha factor of the transistor. If the collector current is 6mA, find I_B and I_E . | 5 |

9. *Answer the following sub-questions :*

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| (a) What is diamagnetism ? Obtain the expression for the Larmor frequency W_L of precession of the angular momentum vector of an atom about the applied magnetic field. | 15 |
| (b) Explain the Hall effect and derive the expressions for the Hall voltage and Hall coefficient. | 10 |
| (c) (i) State and prove the De Morgan's theorem. | 10 |
| (ii) What is AND gate ? Prepare a truth table for a three input AND gate. Draw logic symbol. | 5 |

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