Code No. : 18(II)   *Roll No.* ....

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PHYSICS

Paper : II

Time Allowed : 3 hours]   *[Maximum Marks : 300*

Note : (i) *Answers must be written in English.*

(ii) *Number of marks carried by each question are indicated at the end of the question.*

(iii) *Part/Parts of the same question must be answered together and should not be interposed between answers to other questions.*

(iv) **The answer to each question or part thereof should begin on a fresh page.**

(v) *Your answers should be precise and coherent.*

(vi) *Answer **all** questions. All questions carry equal marks.*

P. T. O.

1. (a) Charge is distributed uniformly along an infinitely long straight line. If λ is the linear charge density obtain expression for the electric field $\vec{E}$ at a point P distant r from the line. Do not use Gauss's law. 20

   (b) State and explain Gauss's law and obtain the result in (a) using Gauss's law. 15

   (c) Plates of a parallel plate capacitor have surface charge densities of $+\sigma$ and $-\sigma$ for $\epsilon = \epsilon_o$. Obtain the expression for the pressure on the plates. 15

OR

   (a) A parallel plate capacitor C, a resistor R, an ideal cell ϵ, an ideal ammeter A and a switch S are arranged in series. What is the current shown by A as soon as S is closed ? Why ? 10

   (b) An L - C- R series circuit is subjected to an AC source, V_{rms} volts and variable angular frequency ω Hz. Obtain the expressions for resonance and quality factor. 30

   (c) Draw circuit diagram of a parallel resonant circuit. 10

2. State and express Maxwell's equations. How does their application, explain the transverse nature of electromagnetic waves ? Obtain an expression for Poynting vector. 50

(2)

OR

(a) State and explain Biot-Savart Law and use it to obtain expression for magnetic field due to a single loop on its axis.   30

(b) Define Self and Mutual inductances.   10

(c) State and explain Kirchoff's Laws used in circuit analysis.   ·10

3. What are the basic postulates of Bohr's theory of hydrogen atom ? Obtain the expression for the energy of a state. How does the Bohr theory explain the hydrogen atom spectrum ? Calculate the energy required to ionise the hydrogen atom.   50

OR

Describe the Stern - Gerlach (SG) experiment and discuss its importance in Quantum Mechanics.

How many lines are expected to be observed if the unpaired electron in an atom is in $l = 3$ state in the SG experiment ? Explain and discuss the $l = 2$ to $l = 1$ transition and the number of spectral lines observed due to normal Zeeman effect.   50

4. Derive the Heisenberg's Uncertainty principle and apply it to obtain zero point energy for a particle in a linear Harmonic Oscillator potential.   50

OR

Solve the Schrodinger wave equation to obtain energy eigen value and eigen function for a particle of a one

dimensional box. Discuss the parity of eigen functions and plot the density distribution for first two eigen functions.

50

5. (a) Discuss the classification of elementary particles and the conservation laws obeyed in strong and weak interactions. Name two Bosons and two Fermions.

30

(b) Obtain expressions for half-life and average-life of a radioactive substance. How are the two related ?

20

6. (a) Explain the physics of intrinsic and extrinsic semiconductors. How does E_F, the Fermi level, change with rise in temperature in both intrinsic and extrinsic semiconductors ?

30

(b) How are diodes used in detection of modulated AM signals ?

20

(4)

400