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Total No. of Questions: [09]

B. Sc. (Hons.) Physics (Semester – 1st)
ELECTRICITY AND MAGNETISM
Subject Code: BPHYS1-101
Paper ID: [19131504]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

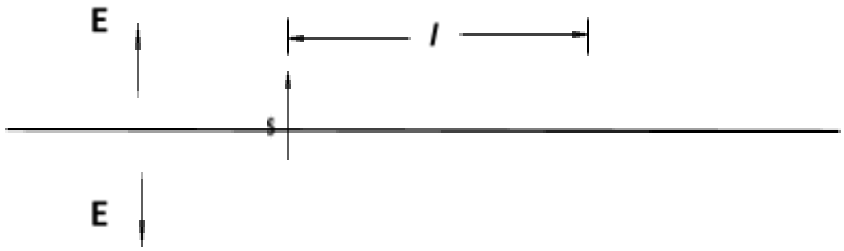
Q1. Attempt the following:

a) Define Laplace and Poisson equations.
b) What are conservative fields?
c) Give the significance of divergence and curl of magnetic field.
d) How would you define vector potential?
e) Why the concept of electric displacement vector (D) is introduced?
f) State the relationship between magnetic flux density (B), magnetic intensity (H), and magnetization (M).
g) Define faraday's law and Lenz's law.
h) Mention the properties of ideal voltage source and ideal current source.
i) State maximum power transfer theorem.
j) Give a brief account of self-inductance and mutual inductance.

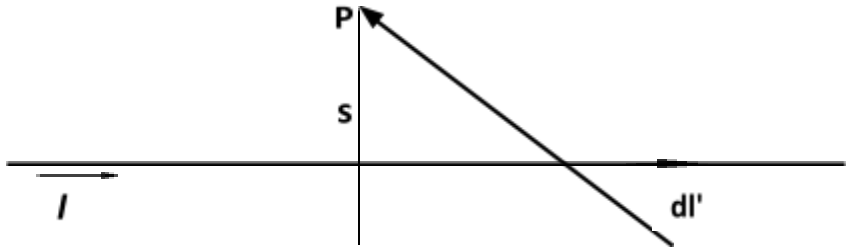
Section – B **(5 marks each)**

Q2. Derive an expression for the electric potential and electric field of a dipole.

Q3. A long cylinder carries a charge density that is proportional to the distance from the axis: $\rho = ks$, for some constant k and s is the radius. Find the electric field inside the conductor.



Q4. Find the magnetic field a distance s from a long straight wire carrying a steady current I.



Q5. What are the Ideal Constant-voltage and Constant-current sources discussed in network theorems? Discuss their existence in detail w.r.t. network theorems.

Q6. Derive the relationship between electrical susceptibility and dielectric constant. Also derive the relations between electric field (E), polarization (P), and electric displacement (D).

Section – C **(10 marks each)**

Q7. Using Ampere's circuital law, find the magnetic field of a very long solenoid, consisting of *n* closely wound turns per unit length on a cylinder of radius *R*, each carrying a steady current *I*.

Q8. Write a short note on:
Magnetic susceptibility and permeability
B-H curve and hysteresis.

Q9. Calculate

a) the resonance frequency and power dissipation for a parallel LCR circuit.

b) the current through the resistance $R_L = 5\Omega$ by applying Norton's Theorem.
(V_1= + 10 V; R_1=3Ω, R_2=6Ω, R_3=3Ω)