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B.Sc. (Hons.) Physics SEM-II (Under CBCS)
ELECTRICITY & MAGNETISM
(BPH-201)

Time : 3 Hours] [Max. Marks : 75

Instructions :

(i) It is compulsory to answer the questions of Part-1. Limit your answers within 20-40 word in this part.

(ii) Answer any four questions from Part-2 in detail.

(iii) Different parts of the same question are to be attempted adjacent to each other.

(iv) Use of non-programmable scientific calculator is allowed.

(v) Assume suitable standard data wherever required, if not given.

PART-1

1. (a) Show that the electrostatic field is conservative in nature. (1.5)

(b) Determine whether the electric field produced by the potential $V = 50x^2 - 75y$ in a given region of space is uniform or not. (1.5)

(c) Obtain the relation between three electric vectors **E**, **P** and **D**. (1.5)

(d) Find the units of the following: (1.5)

(i) $\oint D.ds$ (ii) $\oint E.dl$

(e) What is the physical significance of solenoidal nature of magnetic field? (1.5)

(f) What are the behavior of a capacitor and an inductor towards AC and DC signals? (1.5)

(g) Starting from the integral form, obtain the differential form of Ampere's Circuital Law. (1.5)

(h) Derive the Equation of continuity. (1.5)

(i) What are the characteristics of a constant voltage source and a constant current source? (1.5)

(j) State superposition theorem of linear electrical circuits. (1.5)

PART-2

2. (a) Find the potential inside and outside of a uniformly charged spherical shell (charge Q) of radius R using Gauss Law. (8)

(b) Obtain the expression for the electrostatic energy of a continuous charge distribution. (7)

3. Explain the "Method of Electrical Images". A point charge **q** is placed at a distance **d** in front of a grounded infinite conducting plane. Calculate (i) the potential and the electric field at any point above the plane, (ii) the surface density of induced charge on the conducting plane. What is the total charge induced on it? (15)

4. (a) State Biot-Savan's law. Derive an expression for the magnetic riield at a point due to an infinite long straight current carrying conductor using Biot-Savart's law. (10)

(b) A solenoid is wound with a coil of 200 turns. The coil is carrying a current of 15 amperes. Find the value of magnetic intensity, when the length of the coil is 80 cm. (5)

5. For a series L-C-R circuit obtain an expression for impedance and instantaneous current in the circuit. Discuss graphically the variation of current with frequency at different values of resistance. What is the utility of such a circuit? Calculate the band width (β) in terms of the quality factor (Q) of the circuit. (15)

6. (a) Show how Maxwell modified Ampere's law to make it consistent with the equation of continuity. Explain the significance of the term "Displacement Current". (8)

(b) In a material for which $\sigma = 5$ mho/m and $\varepsilon_r = 1$, the electric field intensity is $\bar{E} = 250 \sin(10^{10}t)$ V/m. Determine the conduction and displacement current densities and the frequency at which they have equal magnitudes. (7)

7. (a) State and prove Maximum Power Transfer theorem for a linear two terminal network. (7)

(b) State & explain Thevenin's theorem. Draw Thevenin's equivalent circuit for the following network. (8)