

AQ-888

M.Sc. Semester—II (CBCS Scheme) Examination

PHYSICS

Paper—2-PHY-1

(Electrodynamics—I)

Time : Three Hours]

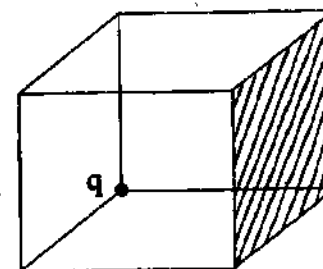
[Maximum Marks : 80

Note :— ALL questions are compulsory and carry equal marks.

1. (a) Calculate the Laplacian of the following function :

$$T_a = x^2 + 2xy + 3z + 4. \quad 4$$

- (b) A charge 'q' sits at the back corner of a cube as shown in fig. What is the flux of 'E' through the shaded side ?



6

- (c) An infinite plane carries a uniform surface charge 'σ'. Find its electric field. 6

OR

5. (a) State and explain the Faraday's law of electromagnetic induction. 6
(b) Derive Poynting vector. 7
(c) What are scalar and vector potentials ? 3

OR

- (p) Show that magnetic energy stored in a series of inductances is given by

$$U = \frac{1}{2} \int_V [\mathbf{H} \cdot (\nabla \times \mathbf{A})] d\mathbf{r}. \quad 6$$

- (q) Show that electromagnetic wave travels in free space with the speed of light. 6
(r) Discuss about Lorentz invariance. 4

- (p) Find the potential inside and outside a uniformly charged sphere whose radius is 'R' and whose total charge is 'q'. 6

- (q) Define potential and derive Laplace's and Poisson's equations. 6

- (r) Find the divergence of the function

$$v = s(2 + sm^2 \phi) \hat{s} + s \sin \phi \cos \phi \hat{\phi} + 3z \hat{z}. \quad 4$$

2. (a) State and prove first uniqueness theorem. 4

- (b) Describe the method of solution of boundary value problem using Green's function. 8

- (c) Obtain expression for potential in spherical coordinates. 4

OR

- (p) A conducting sphere of radius a carrying a charge Q is placed in a uniform field of strength E_0 . Find the potential everywhere. What is the dipole moment of induced charge on the sphere? 6

- (q) Write down Laplace equation in spherical coordinates and obtain its solution. 5

- (r) Describe a method of separation of variables to solve boundary value problems. 5

3. (a) State Amperes law. 2

- (b) In case of magnetic interaction of two current elements $I_1 dl_1$ and $I_2 dl_2$, show that $dF_{12} \neq -dF_{21}$. 8

- (c) Find magnetic field in solenoid. 6

OR

- (p) Define magnetic moment and establish expression for gyromagnetic ratio. 7

- (q) Show that the magnetic field of hollow circular cylindrical conductor carrying current vanishes everywhere inside the hollow region. 9

4. (a) Assuming the negative charge is an atom to be distributed uniformly in a spherical volume of radius R around the nucleus, find an expression for its polarizability. 8

- (b) Define polarizability and derive Claussius-Mossotti relation. 8

OR

- (p) A dielectric sphere is placed in a uniform electrostatic field. Draw a neat diagram showing a distortion produced in the field. Calculate the electric field inside and outside the sphere. 8

- (q) Prove that potential due to polarised medium is expressible in terms of sum of volume and surface integrals. Explain physical meaning of two. 8