

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034
M.Sc. DEGREE EXAMINATION – PHYSICS
SECOND SEMESTER – NOVEMBER 2003

PH 2800 / PH 820 – ELECTRODYNAMICS I

28.10.2003
1.00 – 4.00

Max. : 100 Marks

PART – A

Answer ALL the questions.

(10 x 2 = 20)

01. Explain the statement that “electrostatic energy does not obey a superposition principle”.
02. List any four basic properties of conductors in an electrostatic field.
03. What are the two properties of an electrostatic potential which lead to a solution of Laplace’s equation in 3-dimensions?
04. Define the Legendre polynomial by the Rodrigues formula and hence write down the 3rd order polynomial.
05. Write down the expressions for the torque and the force on an electric dipole placed in an external electric field.
06. State the relation between the applied electric field and the polarization vector in an anisotropic crystal.
07. Define the surface current density and the volume current density in terms of the current $d\vec{l}$.
08. What is a linear magnetic material? State the relation between the magnetic permeability and susceptibility.
09. State Faraday’s law of em induction in differential form.
10. Give an expression for the Maxwell stress tensor.

PART – B

Answer any FOUR questions.

(4 x 7.5 = 30)

11. Find the energy of (a) a uniformly charged spherical shell and (b) a uniformly charged solid sphere.
(3.5 + 4)
12. A point charged is situated near an infinitely grounded conducting plane. By the method of electrical images, find the amount of induced charge.
13. Derive an expression for the potential of an electrically polarized object in terms of bound charged.
14. Explain the mechanism responsible for diamagnetism.

15. Derive an expression for the mutual inductance of a pair of coils.

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PART – C

Answer any FOUR questions.

(4 x 12.5 = 50)

16. a) Find the potential of a uniformly charged spherical shell of radius R for points outside and inside.
(9)

b) Check whether $\vec{E} = k[y^2 \hat{i} + (2xy + z^2) \hat{j} + 2yz \hat{k}]$ is a possible electrostatic field
(k = a constant). (3.5)

17. Obtain the multipole expansion of electrostatic potential of an arbitrary localized charge distribution. Also explain the term “dipole moment” of the distribution.

18. Derive the Clausius – Mossotti formula which relates the polarizability to the dielectric constant.

19. a) Explain the domain theory of ferromagnetism. (5)

b) Bring out the Salient features of a hysteresis loop of ferromagnetic substance (7.5)

20. a) Explain the potential formulation of electrodynamics.

b) Explain the gauge transformation and bring out the differences between the Coulomb gauge and the Lorentz gauge

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