C 2226 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
APRIL 2021

Physics/Applied Physics

PHY 4B 04/APY 4B 04—ELECTRODYNAMICS—I

Time : Three Hours Maximum : 80 Marks

Section A

Answer in a word **or** *phrase.*

Answer **all** *questions ; each question carries* 1 *mark.*

1. $\nabla XB =$ ————————.
2. The Curl of vector field is ————————.
3. A particle is released from rest in to a region in which E is perpendicular B. The particle will undergo ———————— motion.
4. The electric field inside a charged spherical shell is————————.
5. For paramagnetic material, the value of χ is————————.

Questions 6 to 10 write True **or** *False.*

6. Electrostatic energy obeys superposition principle.
7. No work is done in moving a charge from one point to another point on the surface of a conductor.
8. Continuity equation gives the local conservation of charges.
9. Surface current density is the current per unit area.
10. Polarization is the dipole moment per unit volume.

(10 × 1 = 10 marks)

Section B

Answer in two **or** *three sentences.*

Answer **all** *questions.*

Each question carries 2 *marks.*

11. Show that electricfield is the negative gradient of potential
12. State first uniqueness theorem.

Turn over

13. Show that the energy of an ideal dipole in an electric field is-**p.E.**

14. What is a polarizability tensor ?

15. Find the expression relating dielectric constant and electric susceptibility.

16. What is a linear magnetic material ?

17. State Ampere's law in magnetostatics.

(7 × 2 = 14 marks)

Section C

(Answer in **a paragraph** *of about* **half a page** *to* **one page.**
Answer any **five** *questions.*
Each question carries 4 *marks.*

18. Derive the boundary conditions for electric displacement D.

19. Differentiate between paramagnetism and diamagnetism.

20. What do you mean by method of images ? Explain.

21. Find the electric field due to an infinite plane carrying a uniform surface charge σ and comment on the result.

22. Find the work needed to form an assembly of four point charges.

23. Show that the normal derivative of vector potential is discontinuous across a boundary.

24. What is the effect of magnetic field on atomic orbits ?

(5 × 4 = 20 marks)

Section D

Problems-write all relevant formulas.
All important steps carry separate marks.
Answer any **four** *questions.*
Each question carries 4 *marks.*

25. Find the capacitance per unit length of two coaxial metal cylindrical tube of radii '*a*' and '*b*'.

26. A spherical conductor of radius '*a*' carries a charge Q. It is surrounded by a linear dielectric material of susceptibility χ_e, out to radius '*b*'. Find the energy of this configuration.

27. Find the electric field due to a uniformly polarized sphere ?

28. At the interface between two linear dielectrics the electric field lines bend. Show that $\frac{\tan\theta_2}{\tan\theta_1} = \frac{\varepsilon_2}{\varepsilon_1}$, where θ_1 and θ_2 are the angle made by the electric field of the two media with the normal. There is no free charge at the boundary.

29. A long copper rod of radius R carries a uniformly distributed free current I. Find auxiliary field **H** inside and outside the rod.

30. Find the vector potential of an infinite solenoid with '*n*' turns per unit length, radius R and current I.

31. Find the capacitance of a parallel plate capacitor containing two dielectrics with $K_1 = 1.5$ and $K_2 = 3.5$, each occupying one half of the space between the plates with interface parallel to the plates. Given area of the plates equal to 2 m^2 and distance between the plates is equal to 10^{-3} m.

(4 × 4 = 16 marks)

Section E (Essays)

Answer in about **two pages.**
Answer any **two** *questions.*
Each question carries 10 *marks.*

32. State Biot-Savart law. Find the magnetic field due to a circular coil carrying a current I.

33. State and prove Gauss's law in electrostatics. Find the electric field due to a uniformly charged solid sphere. Represent the variation of electric field with distance graphically.

34. What do you mean by ferromagnetism ? Explain the hysteresis curve.

35. What are dielectrics ? Find the expression for force experienced by a dielectric system placed between the plates of a parallel plate capacitor.

(2 × 10 = 20 marks)