

20U407S

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Name:

Reg. No:

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2022

(CUCBCSS-UG)

CC15U PH4 B04 - ELECTRODYNAMICS - I

(Physics – Core Course)

(2016 to 2018 Admission – Supplementary/Improvement)

Time: Three Hours

Maximum: 80 Marks

Section A

Answer *all* questions. Each question carries 1 mark.

1. The value of permittivity of free space is _____
2. The expression for potential at a point due to a charge q in terms of surface charge density σ is _____
3. The expression for electrostatic energy density is _____
4. The relation connecting D, E and P is _____
5. The Laplace equation is given by _____
6. The surface bound charge is given by
a) $\sigma_b = \mathbf{P} \cdot \mathbf{n}$ b) $\rho_b = -\nabla \cdot \mathbf{P}$ c) $\rho_b = \mathbf{P} \cdot \mathbf{n}$ d) $\sigma_b = -\nabla \cdot \mathbf{P}$
7. What is the direction of magnetic field intensity vector due to infinite long current carrying wire?
8. How is magnetic vector potential \vec{A} related with magnetic field intensity \vec{B} ?
9. The temperature at which the magnetic properties of a substance change from ferromagnetic to paramagnetic is known as _____
10. The value of $\nabla \cdot \mathbf{B}$ is _____

(10 × 1 = 10 Marks)

Section B

Answer *all* questions. Each question carries 2 marks.

11. Starting from the integral form of Gauss flux theorem, obtain its differential form.
12. Obtain Poisson's equation and Laplace's equation using Gauss flux theorem.
13. What is meant by polarizability tensor?
14. Distinguish between permittivity and dielectric constant.
15. Explain Lorentz force law.
16. Explain Biot-Savart Law.
17. What is meant by domains of a ferromagnetic material?

(7 × 2 = 14 Marks)

Section C

Answer any *five* questions. Each question carries 4 marks.

18. Define electric potential. Show that electric field is the negative gradient of potential.
19. In the case of electrostatic force field shows that curl E is zero.
20. Explain Cyclotron motion of a charge Q. Obtain an expression for its momentum.
21. Obtain mathematical statement of Continuity equation. Express steady current condition from it.
22. Derive an expression for the force acting on a dielectric in an electric field using the example of a parallel plate capacitor.
23. Obtain the boundary conditions for D in the case of a dielectric-dielectric interface.
24. Explain the bound currents in a magnetized object.

(5 × 4 = 20 Marks)

Section D

Answer any *four* questions. Each question carries 4 marks.

25. Using Gauss flux theorem find the electric flux density inside and outside a charged dielectric cylinder of radius R. Total charge on the sphere is Q.
26. Find magnetic field \vec{B} due to a long current carrying conductor, using Ampere's law.
27. Show that, the relation connecting bound charge and free charge is, $\rho_b = -\left(\frac{\chi_e}{1+\chi_e}\right)\rho_f$
28. A charge $Q_1 = -20\mu\text{C}$ is located at (-6,4,7) and $Q_2 = 50\mu\text{C}$ is located at (5,8,-2) in free space. Find the force on Q_2 by Q_1 . (The distances are in meters).
29. An electric field in a region is given by $\vec{E}_{(x,y,z)} = ax\vec{i} + cz\vec{j} + 6by\vec{k}$. Obtain the condition among the values of a,b,c for which this represent an electrostatic field?
30. Find the magnetic field a distance 's' from a long straight wire carrying a steady current I.
31. Find magnetic field \vec{B} due to a long current carrying conductor, using Ampere's law.

(4 × 4 = 16 Marks)

Section E

Answer any *two* questions. Each question carries 10 marks.

32. Derive an expression for the electric field due to a polarized object in terms of surface bound charge and volume bound charge.
33. Discuss the atomic origin of Paramagnetism and Diamagnetism in detail.
34. State Gauss flux theorem and prove it using a point charge. How will you use it to find the electric field due to a uniformly charged (charge density, λ) line charge of infinite length?
35. (a) How Magnetic forces affect moving charges?
(b) Prove that Magnetic forces impart no work in a moving charge.

(2 × 10 = 20 Marks)
