

15U408

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Name:.....

Reg. No.....

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2017

(CUCBCSS-UG)

Physics - Core Course

CC15U PH4 B04 - ELECTRODYNAMICS I

(2015 Admission)

Time: Three Hours

Maximum: 80 Marks

Section A

(Answer all questions. Each question carries 1 mark)

1. The flux through one face of a cube carrying a charge q at its center is
2. The electric field inside a parallel plate capacitor is
3. Potential difference between two point on a conductor is
4. What is atomic polarizability?
5. Write Gauss's law in the presence of dielectric.
6. The magnetic field due to a long current carrying conductor is
7. Work done by the magnetic field is
8. According to magnetostatic boundary condition, the normal component of \mathbf{B} is
9. A material with negative magnetic susceptibility is
10. Give examples for para and dia magnetic material.

(10 x 1 = 10 marks)

Section B

(Answer all questions. Each question carries 2 marks)

11. Give the importance of Dirac delta function in the theory of electrodynamics.
12. Define electric potential. What is the advantage of potential formulation?
13. Define macroscopic and microscopic electric fields in a dielectric.
14. What is Clausius-Mossotti relation?
15. Define magnetic vector potential.
16. Discuss the physical meaning of the equation $\nabla \cdot \mathbf{B} = 0$.
17. What is cyclotron motion?

(7 x 2 = 14 marks)

Section C

(Answer any five questions. Each question carries 4 marks)

18. Calculate the divergence of electric field due to a continuous charge distribution.
19. Show how the normal component of electric field changes when it crosses the interface of two medium.
20. Obtain an expression for the electrostatic energy of a continuous charge distribution.

21. Find the potential outside a charged cylindrical conductor of infinite length.
22. Derive Ampere's law. Compare it with Gauss's law.
23. Derive continuity equation.
24. Explain B-H curve and hysteresis.

(5x4=20 marks)

Section D

(Answer any four questions. Each question carries 4 marks)

25. A long cylinder carries a charge density that is proportional to the distance from the axis: $\rho = kr$, for some constant k . Find the electric field inside the cylinder.
26. Find the capacitance of two concentric spherical metal shells, with inner and outer radii a and b respectively.
27. Using the method of images find the potential due to a point charge placed at a distance d above a thin conducting plate which is grounded.
28. Calculate the force on a dielectric slab which is partly inserted between the plates of a parallel plate capacitor.
29. An electron orbits around the nucleus of a hydrogen atom along a circular orbit of radius 0.53 \AA with an orbital frequency of 10^{13} Hz . What is magnetic field at the center of the circular orbit?
30. Find the magnetic field of an infinite uniform surface current $\mathbf{K} = k\hat{x}$, flowing over the xy -plane.
31. Find the capacitance of two concentric spherical metal shells with radii 'a' and 'b'.

(4x4=16 marks)

Section E

(Answer any two questions. Each question carries 10 marks)

32. State and prove Gauss's law. Using Gauss's law, find the electric field due to a uniformly charged spherical conductor.
33. Obtain Laplace equation and discuss its properties. Prove first Uniqueness theorem.
34. State Biot Savart law. Derive an expression for magnetic field due to an infinitely long straight conductor and hence find the field at the center of a square loop carrying a current I .
35. Derive expressions for bound current densities \mathbf{J}_b and \mathbf{K}_b . Explain their physical significance.

(2x10=20 marks)
