M 7156

Reg. No. : .....

Name : .....

V Semester B.Sc. Degree (CCSS/Reg./Supple./Imp.)
Examination, November 2014
CORE COURSE IN PHYSICS
5 B06 PHY : Electrodynamics – I

Time : 3 Hours Max. Weightage : 30

PART – A

Choose correct option. **Each** bunch carries 1 weightage.

1. i) Curl of a vector field is
   a) scalar b) vector c) tensor d) both a) and c)

   ii) The number of electrons in one coulomb of charge is
   a) 6.25×10^{18} b) 6.25×10^{19}
   c) 5.25×10^{18} d) 5.25×10^{19}

   iii) If a charge is moved against the coulomb force of an electric field then
   a) work is done by the electric field
   b) energy is used from outside
   c) strength of the field is reduced
   d) energy of the system is decreased

   iv) Potential at a point at a distance 'r' from the centre of a uniformly charged sphere of radius a (<r) is proportional to
   a) a^3 b) r c) $\frac{1}{r}$ d) $\frac{1}{a^3}$

2. i) An electric charge is placed at the centre of a cube of side a. The electric flux through one of its faces will be
   a) $\frac{1}{6}\frac{q}{\varepsilon_0}$ b) $\frac{1}{\varepsilon_0}q$ c) $\frac{6q}{\varepsilon_0}$ d) zero

ii) The mathematical expression for Gauss theorem is

a) $\oint E.\, ds = \varepsilon_0 \sum q$ b) $\oint E.ds = \frac{\sum q}{\varepsilon_0}$

c) $\oint E.ds = \sum q$ d) $\oint E.ds = \frac{\sum q}{4\pi\varepsilon_0}$

iii) In cyclotron the charged particle may be accelerated upto energies

a) several eV b) MeV c) BeV d) KeV

iv) The unit of magnetic induction is

a) Wbm^{-2} b) $WbAm^{-1}$ c) Wbm^{-1} d) Wb **(2×1=2)**

PART – B

Answer **any six** questions. **Each** carries a weightage **1**.

3. What is Dirac-Delta function ?
4. State and explain stokes theorem.
5. What is Coulomb's law ?
6. Give any one application of Gauss's law.
7. Discuss Poisson's equation.
8. Write down the expression for work done in moving a charge.
9. Give the importance of Clausius-Mossotti equation.
10. Explain the basic properties of conduction. **(6×1=6)**

PART – C

Answer **any nine**, **Each** question carries **2** marks.

11. Prove the following identities.
    a) $\nabla \cdot \nabla V = \nabla^2 V$
    b) $\nabla \cdot (\nabla \times A) = 0$.
12. Derive an expression for the energy of a charge distribution.

13. Derive the differential form of Gauss's law. Show that Curl E = 0.
14. Obtain the Laplace's equation in two and three dimensions. Explain the properties of solutions.
15. What are the electrostatic boundary conditions ?
16. A dielectric cube of side a centred at the origin, carries a frozen – in polarization $\vec{P} = k\vec{r}$, where k is a constant. Find all the bound charges and check they add up to zero.
17. What is electric displacement ? State and prove Gauss's law in presence of dielectric.
18. Explain the work needed to move a charge Q through a potential difference V is W = QV whereas the energy stored in a charged capacitor is $U = {}^1/_2 QV$.
19. State and explain Biot Savart law. Use the law to find magnetic field due to infinitely long wire.
20. State and explain Amperes law and apply the same to find the magnetic field at the centre of the Solenoid.
21. What is magnetic vector potential ? Discuss about magneto static boundary conditions.
22. Show that for a charged particle moving with a velocity $\vec{V}$, the magnetic potential is given by $\vec{A} = \frac{\vec{V}}{C^2} V$, where V is the electrostatic potential. **(9×2=18)**

PART – D

Answer **any one**. **Each** question carries **4** W.

23. Derive an expression for the electrical pressure experienced by a charged surface. Hence obtain the expression for the energy density.
24. What is Lorentz force ? Explain. Derive an expression for cyclotron radius and frequency. **(1×4=4)**

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