Roll No. | | | | | | | | | | | | **Total No. of Pages : 03**

Total No. of Questions : 11

B.Sc. (Honours) Chemistry (Sem.-1)

ELECTRICITY AND MAGNETISM

Subject Code : UC-BSHP-112-19

M.Code : 77225

Date of Examination : 17-01-23

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of EIGHT questions carrying TWO marks each.**
2. **SECTION-B contains EIGHT questions carrying FOUR marks each and students have to attempt any SIX questions.**
3. **SECTION-C will comprise of two compulsory questions with internal choice in both these questions. Each question carries TEN marks.**

SECTION-A

1. Write briefly :

a) State Coulomb's law in electrostatics. What do you understand by the flux of an electric field?

b) Provide physical interpretations for the closed surface integrals of **any two** vectors.

c) State Ampere's circuital law.

d) State Gauss's law for electric field.

e) Define electric displacement and explain the significance of the electric displacement vector.

f) What is Gauss law's physical interpretation for the magnetic field?

g) What do you understand by poynting vector?

h) Write Maxwell's four equations in differential form.

SECTION-B

2. Prove that the volume integral of the divergence of a vector field $\vec{A}$ taken over any volume is equal to the surface integral of $\vec{A}$ over the closed surface surrounding the volume *i.e.*

$$\iiint_{V} \vec{\nabla} . \vec{A}\, dV = \oiint_{S} \vec{A} . d\vec{S}$$

3. Using Gauss's theorem calculate the electric field due to a uniform spherical shell of charge at a point (i) outside the shell and (ii) inside the shell. Hence show that for points lying external to it a uniformly charged spherical shell behaves as if the entire charge were concentrated at its center and for point lying inside it the electric field is zero.

4. State and explain Biot-Savart law. Using the concept of the vector potential, derive the expression for Biot-Savart's law.

5. Prove that the line integral of the magnetic field over a closed path enclosing a current-carrying wire is independent of the shape of the path.

6. Consider a vector field $\vec{A} = x^2 \hat{i} + y^2 \hat{j} + z^2 \hat{k}$.

   a. Is the field solenoidal?

   b. Is the field irrotational?

7. If the earth receives 2 cal min^{-1} cm^{-2} solar energy, what would be the amplitudes of electric and magnetic fields of radiation?

8. How was the concept of displacement current helpful in removing discrepancy in Ampere's law?

9. Show that equation of continuity.

$$\vec{\nabla} . \vec{j} + \frac{\partial \rho}{\partial t} = 0$$

is contained in Maxwell's equations.

SECTION-C

10. What are Maxwell's equations? Derive Maxwell's equations (differential form). Discuss the integral form of the above equations. What is the significance of these equations to electricity and magnetism?

OR

Discuss the physical significance of Stokes theorem. Check Stokes theorem using the function $\vec{v} = ay\hat{i} + bx\hat{j}$ (a and b are constants) and the circular path of radius R, centered at the origin in the xy plane.

11. Prove that the power of electromagnetic wave leaving a volume is equal to the difference between the rate of decrease in energy stored in electric and magnetic fields and ohmic power dissipated.

OR

a) Prove that the electric field is a negative gradient of electric potential.

b) Find the electric field at a height z above the center of the square sheet (side **a**) carrying a uniform surface charge σ. Check your results for limiting case $a \to \infty$ and $z >> a$.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.