

Haldia Institute of Technology
Department of Applied Science

Assignment - II

Course: PH 301/PH 401

Module 2: Electrostatics

1. State Coulombs law of electrostatics. Derive Gauss law from Coulombs law.
2. Define electric potential and potential difference. Find the potential and intensity inside and outside of a charged sphere.
3. For an electrostatic field \vec{E} show that $\vec{\nabla} \times \vec{E} = 0$.
4. State and explain Gauss' law in electrostatics. Obtain its differential form and Poisson's law.
5. Using Gauss' law calculates the electric field due to uniformly charged sphere for different positions.
6. Using Gauss law obtain the electric field around a charged hollow sphere.
7. Prove that for an electric field, $\vec{E} = -\vec{\nabla}V$ where V is the potential
8. In hydrogen atom, the distance between the electron and proton is 5×10^{-11} meter. Find the electric force of attraction between them
9. If the electric force in a region is $\vec{E} = 2\hat{i} + 3\hat{j} + \hat{k}$ find the electric flux through the surface area of 50 square units in XY plane.
10. Find a potential and intensity outside and inside of a charged sphere of radius a cm.
11. Can a metal sphere of radius 1 cm hold a charge of 1C.
12. Show that electric field is conservative.
13. An electric field in a region of space is equal to $\vec{E} = 2x\hat{i} + 3y\hat{j} + 2z\hat{k}$ find the volume charge density ρ
14. Using Laplace equations find the potential of a concentric spherical capacitor.
15. Show that the potential $V = V_0(x^2 - 2y^2 + z^2)$ satisfies the Laplace function.
16. Define polar and non polar dielectrics
17. Define dielectric substance? What is meant by polarization in the context of dielectrics?
18. Define atomic polarizability? Establish relation between polarization and atomic polarizability.
19. What do you understand by a dielectric constant of material.
20. What are the polar and non polar dielectrics? What is meant by polarization of dielectric?
Show that $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$.
21. Explain the behavior of dielectrics under static electric fields. Derive a relation between \vec{P} and \vec{E} .
22. Explain the different types of polarization mechanism in dielectrics.
23. What is local field? Obtain an expression for Lorentz equation for local field and hence deduce Clausius-Mossotti relation.

24. Give the relationship between i) \vec{E} , \vec{D} and \vec{P} vectors ii) dielectric constant and vector \vec{P} iii) dielectric constant and dielectric susceptibility. What is the significance of each of these factors?
25. Derive a relation between dielectric constant and refractive index of the dielectric.
26. Explain the phenomenon of spontaneous polarization in ferroelectric materials. Give important applications of ferroelectricity.
27. What is piezoelectricity? Discuss direct and inverse piezoelectric effects. Explain their importance and applications.

28. What is dielectric loss? Show that dielectric loss is given by the relation, $\tan \delta = \frac{\epsilon_r''}{\epsilon_r'}$.