

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
 B.Tech Semester V (EC)
2EC301 Electromagnetic Theory

Tutorial – 2

Topic: Coulomb's law and electric field intensity

1. Two alpha particles are separated by a distance of 1mm and each are having a charge of 3.2×10^{-9} Coulomb. Determine the force of repulsion between them.
2. Calculate the electric field intensity as a distance of 0.2 metre from a charge of $2\mu\text{C}$ in vacuum?
3. Calculate the electrostatic force between two protons in a nucleus of iron with which they repel each other. Assume a separation of 4.0×10^{-15} m between protons.
4. A (+ve) point charge of magnitude $4\mu\text{C}$ is situated in air at the origin of a rectangular co-ordinate system and a second (+ve) charge of $10\mu\text{C}$ is situated on (+ve) z-axis at a separation of 30 cm from origin. Find force on second charge.
5. Four infinite sheets of charge are located as follows: $20\text{pC}/\text{m}^2$ at $y=7$, $-8\text{pC}/\text{m}^2$ at $y=3$, $6\text{pC}/\text{m}^2$ at $y = -1$ and $-18\text{pC}/\text{m}^2$ at $y = -4$. Find \vec{E} at the point : (a) $P_A (2,6,-4)$; (b) $P_B (0,0,0)$; (c) $P_C (-1,-1,1.5)$.
6. A Charge $Q_0 = 1 \text{ nC}$ is located in free space at $P(a, 0,0)$ Prepare a sketch of the magnitude of the force on Q_0 as a function of a , $0 \leq a \leq 5\text{m}$, produced by two other charges, $Q_1 = 1\text{C}$ at $(0,1,0)$ and $Q_2 =$: (a) 1C at $(0,-1,0)$; (b) -1C at $(0,-1,0)$.
7. A point charge, $Q_A = 1\mu\text{C}$, at $A (0, 0, 1)$ and $Q_B = -1\mu\text{C}$ is at $B (0, 0,-1)$. Find E_r , E_θ and E_ϕ at $P (1, 2, 3)$.
8. A sheet of charge, $\rho_s = 2\text{nC} / \text{m}^2$, is present at the plane $x = 3$ in free space, and a line charge, $\rho_L = 20\text{nC} / \text{m}$, is located at $x = 1, z = 4$. (a) Find the magnitude of the electric field intensity at the origin. (b) Find the direction of \vec{E} at $P(4, 5, 6)$. (c) What is the force per meter length on the line charge ?

9. Three (+ve) charges of magnitude q , $2q$, $3q$ are placed in 3 corners of equilateral triangle. Find the magnitude and direction of \vec{E} at the point bisecting the line joining q and $2q$ if the length of each side of triangle is 'a'.
10. Determine the electric field due to spherical cloud of electrons giving the volume charge density of

$$\begin{aligned}\rho_v &= -\rho_o & 0 \leq r \leq R \\ &= 0 & r > R.\end{aligned}$$

Find electric field.