ARAB ACADEMY FOR SCIENCE & TECHNOLOGY & MARITIME TRANSPORT
COLLEGE OF ENGINEERING & TECHNOLOGY
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Electromagnetics
Course # EC341
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Sheet (4)

1. Find the work done in moving a 5μC charge from the origin to P(2, –1, 4) through the field.
$\overline{E}$ = 2xyz $\hat{a}_x$ + x²z $\hat{a}_y$ + x²y $\hat{a}_z$ V/m, via the path:
   a. straight line segments: (0, 0, 0) to (2, –1, 0) to (2, –1, 4)
   b. straight line: x = –2y, z = 2x

2. Find the work done in moving a point charge Q = 5μC from the origin to the point (2m, π/4, π/2), spherical coordinates, in the field
$\overline{E} = 5\, e^{-rs/4}\, \hat{a}_{rs} + \frac{10}{r_s \sin\theta}\, \hat{a}_{\emptyset}$ V/m

3. Let $\overline{E} = (\frac{-6y}{x^2})\, \hat{a}_x + (\frac{6}{x})\, \hat{a}_y + 5\, \hat{a}_z$ V/m , and calculate :
   a. V_{PQ} given P(7, 2, 1) and Q(4, 1,2).
   b. V_P if V = 0 at Q.
   c. V_p if V = 0 at (2, 0, –1).

4. A point charge of 6 nC is located at the origin in free space. Find V_P if point P is located at (0.2, –0.4, 0.4) and;
   a. V= 0 at infinity.
   b. V=0 at (1, 0, 0).
   c. V=20 volt at (–0.5, 1, –1).

5. A circular ring of radius a (located on the x – y plane and centered at the origin), is charged uniformly over one half of its length ($0 \le \varphi \le \pi$) with ρ_{L1} C/m and over the other half ($\pi \le \varphi \le 2\pi$) with ρ_{L2} C/m. Find the electric potential V at point P(0,0,h).

6. In spherical coordinates, point A is at a radius 2m while B is at 4m. Given the field $\overline{E} = (-16/r_s^2)\,\hat{a}_{rs}$ V/m, find the potential of point A, zero reference at infinity. Repeat for point B.

7. A uniform line charge ρ_L = 2 nC/m lies in the z = 0 plane parallel to the x-axis at y = 3m. Find V_{AB} for points A(2m, 0, 4m) and B(0, 0, 0).

8. A uniform sheet of charge $\rho_s = (\frac{1}{6\pi})$ nC/m² is at x = 0 and a second sheet $\rho_s = (\frac{-1}{6\pi})$ nC/m² is at x = 10m. Find V_{AB}, V_{BC}, and V_{AC} for A(9m, 0, 0) , B(4m, 0, 0) , and C(1, 0, 0).

9. If the potential difference between two points at distances of 0.1m and 0.2m from a point charge Q is 10V, Find Q.

10. Find the electric field ($\overline{E}$) associated with each of the following potential fields

    a. $V(x, y, z) = 3x^2y - y^3z^2$.

    b. $V(rc, Ø, z) = r_c\,(1 - \frac{b}{r_c^2})\cos Ø$.

    c. $V(r_s, \theta, Ø) = a\,r_s \cos\theta + \frac{b^3}{r_s}\cos\theta$.

11. A thin loop in the form of square of side a carries a uniform charge of density ρ_L C/m. show that the potential at the center of the loop is given by

    $V = (2\rho_L/\pi\,\varepsilon_o) * \ln(1 + \sqrt{2})$.

12. A uniform circular cylindrical surface of radius **a** and length **L** carries a total charge **q** distributed uniformly over its surface. Find the potential at any point on the axis.

13. A cone has a total charge **Q** uniformly distributed over its surface. Calculate the potential at the apex of the cone, the apex angle of the cone is **2*α***, and its height is **h**.

14. Find the stored energy in a system of four identical point charges, Q = 4nC, at the corners of square 1m on a side. What is stored energy in the system when only two charges at opposite corners are in place?

15. What energy is stored in the system of two point charges, Q_1 = 3nC and Q_2 = –3nC, separated by a distance of d = 0.2 m?