Department of Electrical Engineering
Assignment
B.tech(E)
Date: 14/04/2020

Course Details

Course Title: Electromagnetic Fields **Module:** 4th
Instructor: Eng perniya Akram **Total Marks:** 30

Student Details

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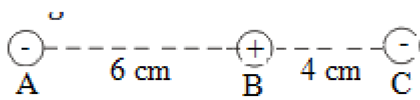
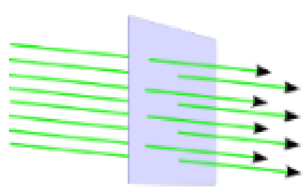
Q1.	(a)	State the relationship between potential and electric field intensity with relevant example.	Marks 5
	(b)	Consider a point A(1,-2,2), Find a unit vector extending from point A.	Marks 5
Q2.	(a)	Three charged particles are arranged in a line as shown in figure below. Charge A = -3 μC, charge B = +8 μC and charge C = -9μC. Calculate the net electrostatic force on particle B due to the other two charges. 	Marks 10
Q3.	(a)	a) A uniform electric field E = 6000 N/C passing through a flat square area A = 10 m^2. Determine the electric flux. 	Marks 5
	(b)	'Electric flux density is a function of charge', Comment how and explain the effect of charge on flux density.	Marks 5

Question NO 1

Part (A)

Relation ship between potential and Electric fiel intensity.

Electric Field intensity is equal to the nagative of rate of change of potential with respect to the distance or it Can be defined as the difference. v with respect to r $E = -dv/dr$

$\vec{F} = q_0 E$

$\vec{E} = \frac{F}{q_0}$

in other words the relationship between potential and Fiel (E) is a differential Electric field is the gradient of potential (v) in the x direction. This can be represented as $Ex = -dv/dx$ $Ex = -dv/dx$

Thus as the test charge is moved in the x direction the rate of the its change in potential is the value of the electric Field.

Exampl of Electric Field.

Light X-rays radio waves, microwaves etc. electric Field Component's in it. There is external electric Fiel in a current Carrying Conductor. Electric Field are generated by charges and charge configration such as capacitors.

Example of Potential Energy

- A Coild Spring
- Water that is behind dam
- A Stretched Rubber band
- A raised weight
- Wheels on roller skates before Someone skates.

Question No 1
part B

Consider a point A(1,-2,2) Find a Unit vector extending from point A

Solution

let Suppose

$A = 1a_x - 2a_y - 2a_z$

$|A| = \sqrt{(1)2 + (-2)2 + (-2)2}$

So: Magnitude of 'A'

$1+4+4$

$\sqrt{9} = 3$

Find unit vector

$a_A = \frac{A}{|A|} = \frac{a_x - 2a_y - 2a_z}{2}$

$$= \frac{1}{2}ax - \frac{2}{2}ay \ \frac{2}{2}az$$

$$aA = 0.333ax - 0.666ay - 0.666az$$

Q:: 2 Three charged particles are arranged in a line as shown in figure below Charge A = -3 μC charge B = +8 μC and Charge C = -9 μC. Calculate the net electrostatic force on particle B due to other two charges.

Solution

Give data

$$\text{Charge } A = Q_A = -3\mu C = -3 \times 10^{-6} C$$

$$\text{Charge } B = Q_B = 8\mu C = 8 \times 10^{-6} C$$

$$\text{Charg } C = Q_C = -9\mu C = -9 \times 10^{-6} C$$

Find the magnitude and the direction of net electromagnetic porce a particles B the force exerted on particle B by partic A

$$F_{AB} = k \frac{q_A q_B}{AB}$$

$$F_{AB} = 9\times10^{9} \frac{-3\times10^{-6}(8\times10^{-6})}{(6\times10^{-2})^2}$$

$$= \frac{9\times10^{9}(-24\times10^{-12})}{36\times10^{-4}}$$

$$F_{AB} = \frac{-216\times10^{-3}}{36\times10^{-4}}$$

$$F_{AB} = -6\times10^{-3}\times10^{4}$$

$$F_{AB} = -6\times10^{1}$$

$$\boxed{F_{AB} = -60\,N}$$

So The direction of the electrostatic force points to particles 'A' point left the force F_{Bc} exarted on perticle B by A.

$$F_{Bc} = k\frac{q_b q_c}{r_{Bc}}$$

$$F_{BC} = 9\times10^{9}\ \frac{8\times10^{-6}(-9\times10^{-6})}{(4\times10^{-2})^2}$$

$$F_{BC} = \frac{9\times10^{9}(-72\times10^{-12})}{16\times10^{-4}}$$

$$F_{BC} = \frac{-648\times10^{-3}}{16\times10^{-4}}$$

$$F_{BC} = -40.5\times10^{-2}\times10^{4}$$

$$F_{BC} = -40.5\times10^{1}$$

$$\boxed{F_{BC} = -405\ N}$$

The net electrostatics force on particles B

$$F_b = F_{ab} - F_{bc}$$

Putting the value

$$F_b = (-60) - (-405)$$

$$\boxed{= 345\ \text{Newton}}$$

Question NO 3
part 'A'

A Uniform electric Field $E = 6000\ N/C$ Passing through a Flat Squre area $A = 10m^2$. Determine the electric Flux.

Solution

Given data

$E = 6000\ NC$

$A = 10m^2$

we know that

$\phi = EA\cos\theta$

ϕ = electric flux (Nm^2/C)

E = electric Field (NC)

A = Area (m^2)

θ = angle between electric Field

Let Suppose

$\Phi_e = EA\cos\theta \Rightarrow (1)$

putting value in equation (1)

$\Phi_e = (6000)(10)(\cos\theta)$

$= (6000)(10)(1)$

$= 6 \times 10^4 Nm^2C$

Question No 3

part B

Q:, 3 Electric Flux density is function of charge Comment how and explain the effect of charge on flux density.

Ans :→

Electric flux density is a measure of the strength of an electric field generated by free electric charge. The number of electric lines of force passing through a given area. Electric flux density is electric flux passing through a unit area perpendicular to the direction of flux.

Electric flux density assigned the symbol 'D' is an alternative to electric field intensity (E) as a way to quantity an electric field. This alternative description offer some actionable insight as we shall point out at the end of this section.

Electric flux density Recall that a particle having charge q gives rise to the electric field intensity:

$$R' q \; 14\pi R_2 \; E = R' q \; 14\pi R_2 \; 1\varepsilon$$

where R is distance from the Charge and $\hat{R}$ point away from the Charge. E is inversely proportional to $4\pi R_2$ indicating that E decreases in proportion to the area of a Sphere Surrounding the Charge

Now integrate both Side of equation over a Sphere 'S' of redius 'R'

Factoring out constants that do not very with the variables of integration. the right hand Side becomes.

Note that $ds = \hat{R}ds$ in this Case, and also that $\hat{R} = 1$ Thus, the Right-hand Side Simplifies to.

$q \; 1 4\pi R_2 1 \pi \oint S \, ds$