Faculty of Engineering and Technology

Electrical and Computer Engineering Department

Electromagnetics 1 (ENEE 3408)

MATLAB Assignments

Prepared by

Yazan Yousef – 1170249

Section No. 1

Instructor

Dr. Ashraf Al-Rimawi

BIRZEIT

April 2020

Q1:-

$$E\text{-}Q1 = \frac{kQ_1}{r^3} \cdot \vec{r}$$

$$= \frac{(9\times10^9)(8\times10^{-9})}{(1.4142)^2}\left[0\hat{a}_x + -\hat{a}_y - \hat{a}_z\right]$$

$$= 0\hat{a}_x - 25.4558\,\hat{a}_y - 25.4558\,\hat{a}_z$$

$$E Q_2 = \frac{k Q_2}{r^3}\vec{r}$$

$$= \frac{(9\times10^9)(8\times10^{-9})}{(1.4142)^2}\left[0\hat{a}_x + 1\hat{a}_y - 1\hat{a}_z\right]$$

$$= 0\hat{a}_x + 25.4558\,\hat{a}_y + -25.4558\,\hat{a}_z.$$

$$E\_Line = \frac{k\rho_L}{z}\left(\frac{2a}{\sqrt{z^2+a^2}}\right)\left[\vec{R}\right]$$

$$= \frac{(9\times10^9)(4\times10^{-9})}{4.9497}\left(\frac{(2)(4.9497)}{\sqrt{(4.9497)^2+(4.9497)^2}}\right)\left[3.5\hat{a}_x + 3.5\hat{a}_y + 0\hat{a}_z\right]$$

$$= -7.2731\hat{a}_x - 7.2731\hat{a}_y + 0$$

$$\boxed{E_{TOT} = -7.2731\,\hat{a}_x - 7.2731\,\hat{a}_y - 50.9117\,\hat{a}_z}$$

Code:

```
clear;
clc;

Q1 = 8e-9;
Q2 = 8e-9;
ro_L = 4e-9;
line_initial_point = [7 0 0];
line_final_point   = [0 7 0];

Point_Q1 = [0 1 1];
Point_Q2 = [0 -1 1];
Point_EF = [0 0 0];
epsilon = (1e-9/(36*pi));
k = (1/(4*pi*epsilon));

R_Q1E  = Point_EF - Point_Q1;
R_Q2E  = Point_EF - Point_Q2;

R_LIP  = (Point_EF - line_initial_point);
R_line = (line_final_point - line_initial_point);

Mag_R_Q1E  = norm(R_Q1E);
Mag_R_Q2E  = norm(R_Q2E);

Mag_R_line = norm(R_line);
Mag_LIP = norm(line_initial_point);

cos_theta = (dot(R_line , R_LIP)/(Mag_R_line*Mag_LIP));
sin_theta = sqrt(1-(cos_theta)^2);

z = Mag_LIP*sin_theta

a = Mag_LIP*cos_theta;
b = Mag_R_line - a;

Point_z = [3.5 3.5 0];
Mag_z_vector = norm(Point_z);
R_z = (Point_EF - Point_z)./(Mag_z_vector);


EQ1 = (k*Q1/(Mag_R_Q1E)^3).*R_Q1E;
EQ2 = (k*Q2/(Mag_R_Q2E)^3).*R_Q2E;


E_line = (k*ro_L/z)*((b/sqrt(z^2 + b^2))+(a/sqrt(z^2 + a^2)))*R_z

E_Tot = EQ1 + EQ2 + E_line

Result
= -7.2731   -7.2731  -50.9117
```

Q2 :

$$E = \frac{D}{2\epsilon_0}\left(1 - \frac{z}{\sqrt{z^2 + R^2}}\right)$$

$$E = \frac{2\mu}{2\epsilon_0}\left(1 - \frac{1}{\sqrt{2}}\right)\left[0\hat{a}_x + 0\hat{a}_y + 1\hat{a}_z\right]$$

$$\boxed{E = 0\hat{a}_x + 0\hat{a}_y + 3.308\times10^{4}\,\hat{a}_z}$$

Code:

```
clc;
clear;

Epsilono=8.854e-12;
D=2e-6;

P=[0 1 0];
R = 1;
Z = 1;

E =(D/(2*Epsilono))*(1-(Z/(sqrt(Z^2+R^2))));

E_tot = E.*[0 0 1]
```

Result =

E_tot =

```
  1.0e+04 *

       0         0    3.3080
```

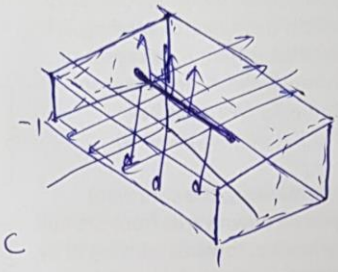
Q4:

$\rho_L = 2\,\mu C/m$

Find [Ψ from $x = 0$ to $x = 1$] :

Gauss surface of a cube.

Charge enclose =



$2m \cdot \frac{2\,\mu C}{m} = \boxed{4\,\mu C}$

The total flux is $4\,\mu C$

Passing through 4 sides.

so one side has a flux of

$\boxed{1\,\mu C}$

but we only need half a side

So → $\boxed{\text{flux} = 0.5\,\mu C}$

Code:

```
clc;            %clear the command line
clear;          %remove all previous variables

ro_L = 2e-6;
L_start = [0 -1 1];
L_end = [0 1 1];
Line = L_end - L_start;
Mag_Line = norm(Line);
Total_Charge_Q = ro_L*Mag_Line;
Line_Charges = 10000;
Q = Total_Charge_Q/Line_Charges;

az=[0 0 1];        % unit vector in the z direction

x_lower=0;    %the lower boundary of x of the plane
x_upper=1;    % the upper boundary of x of the plane
y_lower=-100;      %the lower boundary of y of the plane
y_upper=100;       %the upper boundary of y of the plane
Number_of_x_Steps=20;      %step in the x direction
Number_of_y_Steps=1000;    %step in the y direction
dx=(x_upper-x_lower)/Number_of_x_Steps;            %the x increment
dy=(y_upper-y_lower)/Number_of_y_Steps;            %the y increment
dP = Mag_Line/Line_Charges;

flux=0;     %initialize the flux to 0
y1 = 4*pi;
ds = dx*dy;

for p = -1+dP : dP : 1-dP
for j=1:Number_of_y_Steps
for i=1:Number_of_x_Steps

    x  = x_lower+0.5*dx+(i-1)*dx;  %x component of the center of a grid
    y  = y_lower+0.5*dy+(j-1)*dy;  %y component of the center of a grid
    P  = [x y 0];                            %the center of a grid
    C  = [0 p 1];
    R  = P-C;   %vector R is the vector pointing from the point charge

    RMag  = norm(R);   %magnitude of R
    R_Hat = R/RMag;    %unit vector in the direction of R

    flux = flux + Q*ds*(-1*R_Hat(3))/(y1*RMag^2end
end
end
```

flux =

4.9995e-07

Q5 :

A : [3 , 4, 12]

B : [2, 2, 2]

$r_A = \sqrt{196} = 13$

$r_B = \sqrt{12}$

$$V_A = \frac{1.5 - 1}{\epsilon_0} \cdot \frac{1}{r_A}$$

$= 4.3499 \times 10^9$ volt

$$V_B = \frac{1.5 - 1}{\epsilon_0} \cdot \frac{1}{r_B}$$

$= 1.6324 \times 10^{10}$ volt

$V_{AB} = V_B - V_A$

$= 1.1974 \times 10^{10}$ volt

Code:

```
clear;
clc;

epsilon = (1e-9/(36*pi));

A = [3 4 12];
B = [2 2 2];

r_A = norm(A);
r_B = norm(B);

VA = (0.5/epsilon)*(1/r_A)
VB = (0.5/epsilon)*(1/r_B)

VAB = VB - VA
```

VAB =

1.1974e+10