Experiment :-05

(1) Plots of Electric field and Electric potential due to charge distributions.

Commands (a) slice (X, Y, Z, V, x slice, y slice, z slice) (b).
(b) shading interp (c) colormap hsv (d) colorbar (e) axis square

1. Two point charges of 8 nC each are located at (0,0,1) & (0,0,-1).
(a) Find the electric field at point (2,3,4). Write a Matlab Program and verify the answer obtained analytically.
(b) Also find the potential at point (2,3,4) and verify with Matlab.

$\epsilon_0 = 8.854 \times 10^{-12} \approx \frac{10^{-9}}{36\pi}$ F/m or $k = \frac{1}{4\pi\epsilon_0} \approx 9 \times 10^9$ m/F

2. Determine $\vec{D}, \vec{E}$ at (4,0,3) if there is a line charge 3π mC/m along the y-axis. [Hint $\vec{D} = \epsilon_0 \vec{E}$ and $\vec{E} = \frac{\rho_L}{2\pi\epsilon_0 s} \hat{a}_s$ (see text)]

3. (a) Using Matlab, plot the electric field due to a point charge at origin (0,0,0) based on the equation $\vec{E} = \frac{1}{x^2+y^2+z^2}$.
Plot it over the domain $-1 \le x \le 1$, $0.001 \le y \le 1$, $-1 \le z \le 1$
Title it 'Electric field (log magnitude) due to point charge at origin'.

(4) Using Matlab, plot the electric field due to a line charge along z-axis based on the equation $E = \frac{1}{\sqrt{x^2+y^2}}$. Plot it over the domain as specified in Ques 3. and title it accordingly.

(5) Determine magnitudes of $\vec{D}$ and $\vec{E}$ for an infinite sheet of uniform charge at P(1,-1,-1) $\rho_s = 0.36\pi$ C/m^2 lying on the plane $z = 0$. Remember $\vec{D} = D_z \hat{a}_z$.
(Hint) $\vec{D} = \frac{\rho_s}{2} \hat{a}_z$ and $\vec{E} = \frac{\rho_s}{2\epsilon_0} \hat{a}_z$

(6) Using Matlab, plot the electric field due to a sheet charge based on the equation $\vec{E} = -(3x^3y^2)/(2) - (3x^2y^3)/2 + (45x^2y^2)/4$ over the domain specified in Ques 4.

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Commands used in program:

a) Slice(X,Y,Z,V,xslice,yslice,zslice) draws slices for the volumetric data V. Specify X,Y, and Z as the coordinate data.

b) Colormap hsv- = hsv returns the hsv colormap as a three-column array with the same number of rows as the colormap for the current Figure.

c)Colorbar-colorbar displays a vertical colorbar to the right of the current axes or chart. Colorbars display the current colormap and indicate the mapping of data values into the colormap.

d)shading interp-shading interp varies the color in each line segment and face by interpolating the colormap index or true color value across the line or face.

Qno1.

```
% a) Finding the Electric Field at point (2,3,4) of a system having two
% charges placed at (0,0,1) & (0,0,-1)
Q1=8*10^(-9);
Q2=8*10^(-9);
Obser=[2,3,4]
Sc1=[0,0,1];
R1=Obser-Sc1
R1m=(22)^0.5;
Sc2=[0,0,-1];
R2=Obser-Sc2
```

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```
R2m=(38)^(0.5);
E1=(((9*10^(9))*Q1)/(R1m)^3).*R1
E2=(((9*10^(9))*Q2)/(R2m)^3).*R2
E3=E1+E2
%%
% b) Electric Potential at point (2,3,4) of the given system.
Q1=8*10^(-9);
Q2=8*10^(-9);
Obser=[2,3,4]
Sc1=[0,0,1];
R1=Obser-Sc1
R1m=(22)^0.5;
Sc2=[0,0,-1];
R2=Obser-Sc2
R2m=(38)^(0.5);
V1=(9*10^(9)*Q1/R1m)
V2=(9*10^(9)*Q2/R2m)
Vnet=V1+V2
```

Output:-

Obser = 2 3 4

R1 =2 3 3

R2 =2 3 5

E1 =1.3955 2.0932 2.0932

E2 =0.6147 0.9221 1.5368

E3 = 2.0102 3.0153 3.6301

Obser = 2 3 4

R1 = 2 3 3

R2 =2 3 5

V1 =15.3505

V2 = 11.6799

Vnet = 27.0304

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Qno .2

```
e=3*pi*(1e-3)
u=8.8419e-12
r1=[4,0,3]
r2=[0,0,0]
r=r1-r2
r4=r/(norm(r))
E=(e/((2*pi*u*norm(r))))*(r4)
D=u*e
```

Output:-

e = 0.0094

u = 8.8419e-12

r1 = 4 0 3

r2 = 0 0 0

r = 4 0 3

r4 =Columns 1 through 2

0.8000 0

Column 3

0.6000

E = 1.0e+07 *

Columns 1 through 2

2.7143 0

Column 3

2.0358

D =

8.3333e-14

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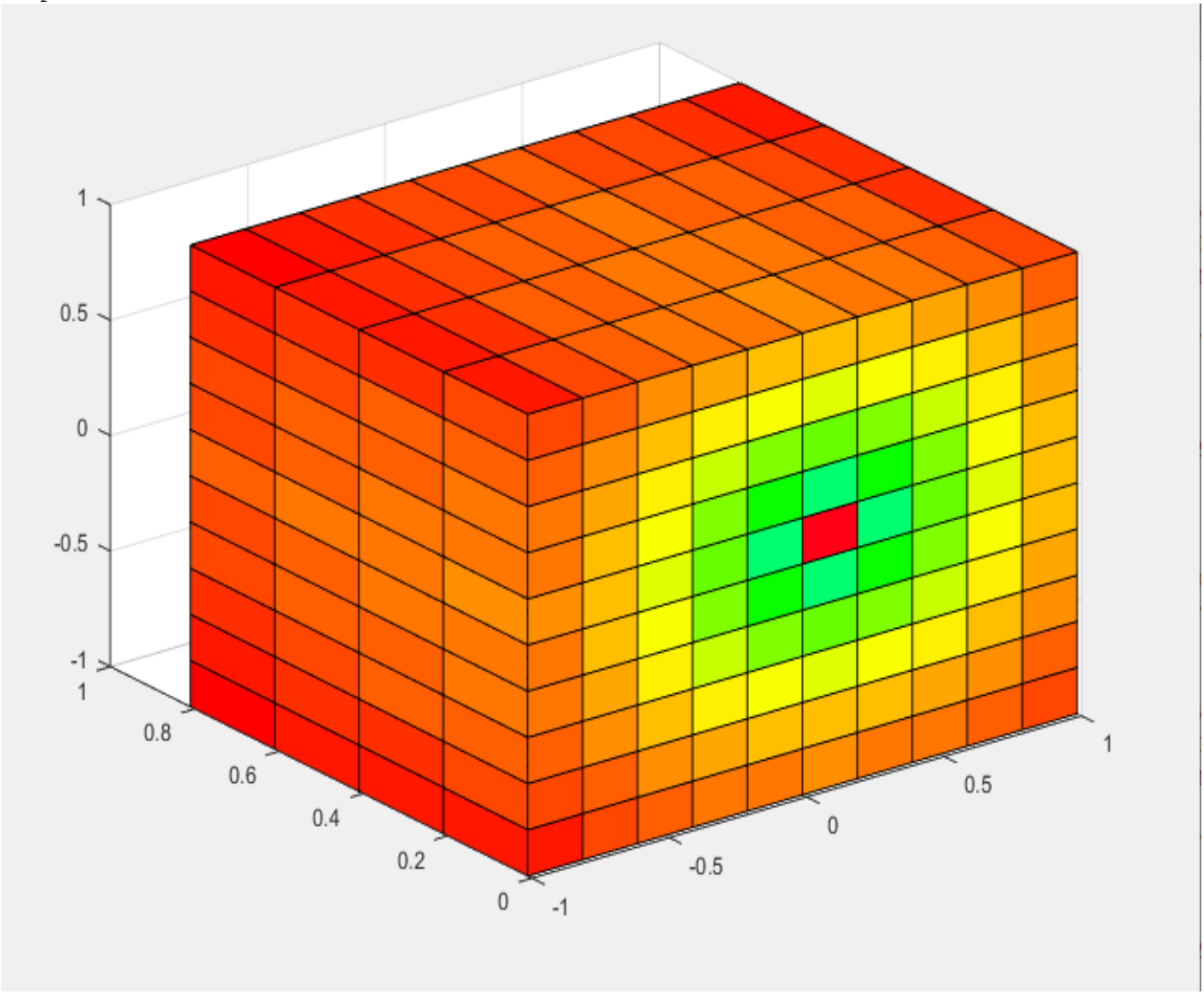
Qno.03

```
[x,y,z]=meshgrid(-1:0.2:1,0.01:0.2:1,-1:0.2:1);

V=log(N);
Xslice=[-1:0.2:1];
yslice=[0.01:0.2:1];
zslice=[-1:0.2:1];
slice(x,y,z,V,Xslice,yslice,zslice)
colormap hsv;
Xlabel('x')
Ylabel('y')
Zlabe('z')
Title('elecrtic field due to a point charge at origin')
Colorbar
```

Output:-



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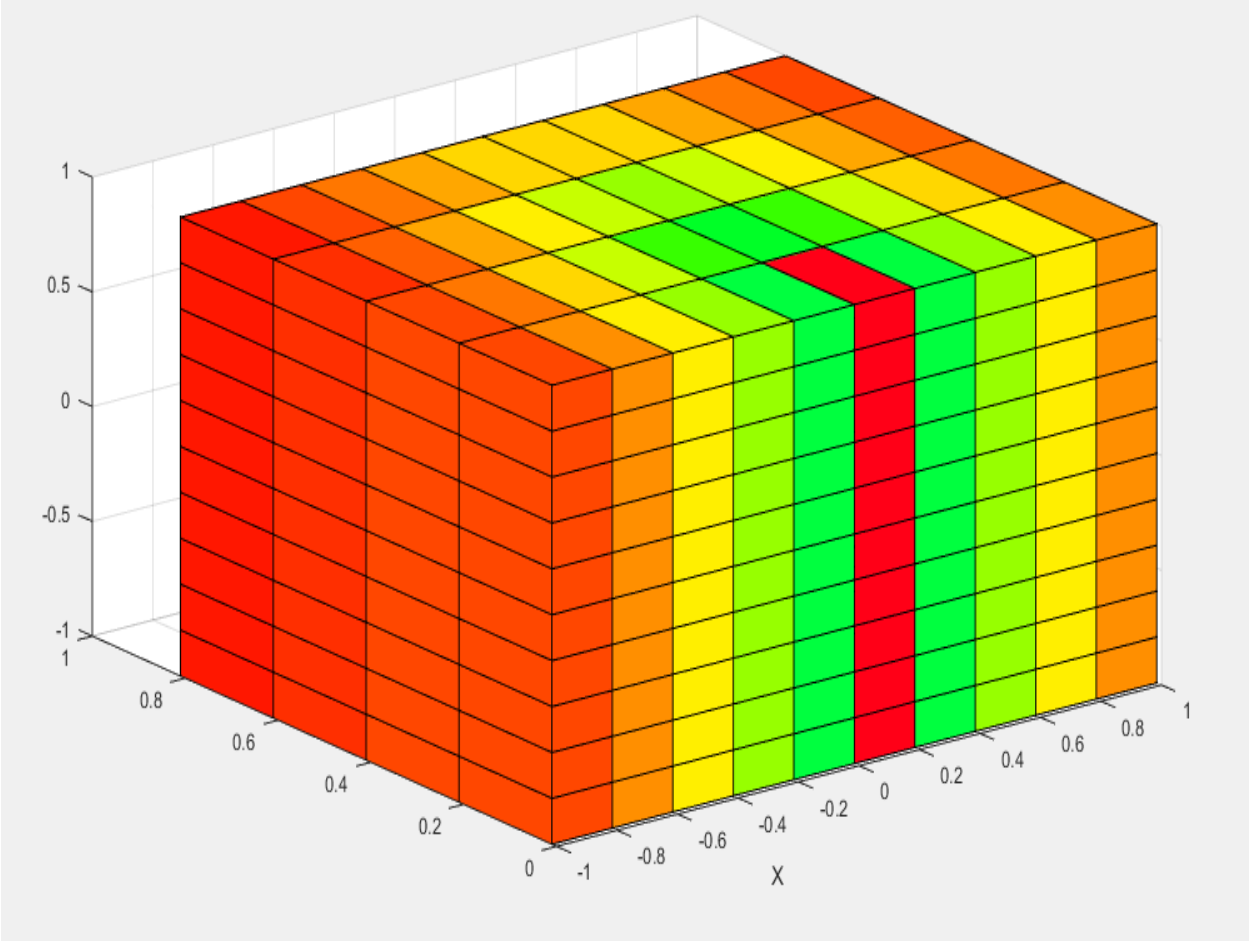
Qno.04

```
[x,y,z]=meshgrid(-1:0.2:1,0.01:0.2:1,-1:0.2:1);
N=1./(sqrt(x.^2+y.^2));
V=log(N);
Xslice=[-1:0.2:1];
yslice=[0.01:0.2:1];
zslice=[-1:0.2:1];
slice(x,y,z,V,Xslice,yslice,zslice)
colormap hsv;
xlabel('X')
Ylabel('y')
Zlabel('z')
Title('elecrtic field due to a line charge at origin z')
colorbar;
```

output:-



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Qno.05

```
P=[1,1,-1];
R=0.36*pi;
N=808516e-12
E_mag=r/(2*N)
D_mag=r/2
```

Output :-

N = 8.0852e-07

E_mag = 1.0e+06 *

Columns 1 through 2

2.4737 0

Column 3

1.8553

D_mag =

Columns 1 through 2

2.0000 0

Column 3

1.5000

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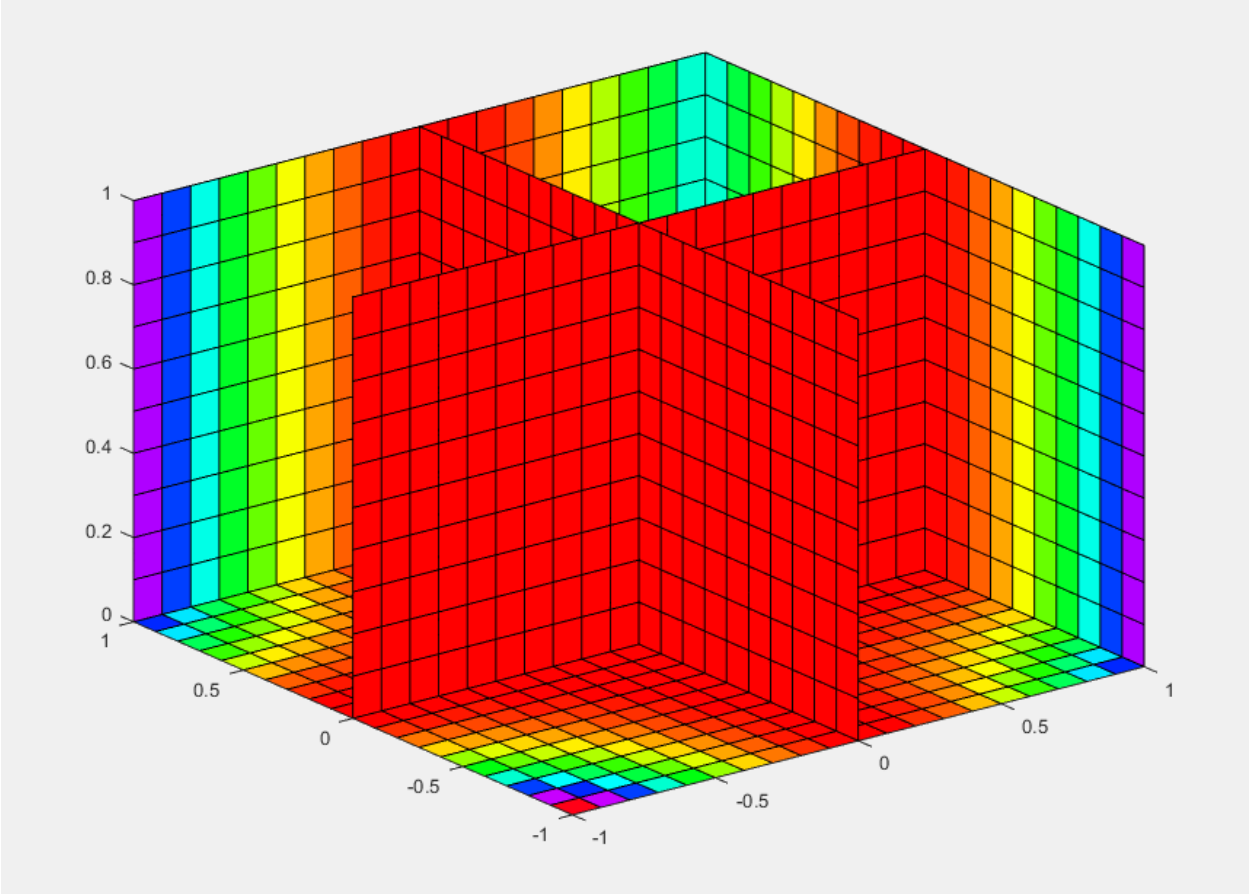
Qno.6

```
[x,y,z]=meshgrid(-1:0.1:1,-1:0.1:1,0:0.1:1);

N=-(3.*x.^3.*y.^2)/2-(3.*x.^2.*y.^3)/2+(45.*x.^2.*y.^2)/4;
Xslice=[0:1];
yslice=[0:1];
zslice=[0];
slice(x,y,z,N,Xslice,yslice,zslice)
colormap hsv;
Xlabel('x');
Ylabel('y');
Zlabe('z');
Title('elecrtic field due to a sheet charge at origin')
colorbar;
```

Output :-



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