

MATLAB EXERCISE 1.7 **Electric field due to multiple charges.** In MATLAB, calculate and plot the electric field intensity vector due to N point charges placed at arbitrary locations in a Cartesian coordinate system, in free space, based on Eq.(1.9) (from the book) and the program developed in MATLAB Exercise 1.4. (*ME1-7.m on IR*)

SOLUTION:

```

%
% Book: MATLAB-Based Electromagnetics (Pearson Prentice Hall)
% Author: Branislav M. Notaros
% Instructor Resources
% (c) 2011
%
% This MATLAB code or any part of it may be used only for
% educational purposes associated with the book
%
%
% Electric field due to multiple charges

clear all;
close all;
EPS0 = 8.8542*10^(-12);
N = input('Enter the number of point charges: ');

% Input

for i = 1:N
    x(i) = input(['Enter the X coordinate in cm for charge ',int2str(i),': ']);
    y(i) = input(['Enter the Y coordinate in cm for charge ', int2str(i),': ']);
    z(i) = input(['Enter the Z coordinate in cm for charge ', int2str(i),': ']);
    Q(i) = input(['Enter the charge in nC for charge ',...
        int2str(i),': ']);
end

xp = input('Enter the X coordinate in cm of the point of interest: ');
yp = input('Enter the Y coordinate in cm of the point of interest: ');
zp = input('Enter the Z coordinate in cm of the point of interest: ');

x = x * 10^(-2);
y = y * 10^(-2);
z = z * 10^(-2);
Q = Q * 10^(-9);

xp = xp * 10^(-2);
yp = yp * 10^(-2);
zp = zp * 10^(-2);

% Compute distance and direction between observation point and each charge

r = sqrt((xp - x).^2 + (yp - y).^2 + (zp - z).^2);
ux = (xp - x)./r;
uy = (yp - y)./r;
uz = (zp - z)./r;
uVec = [ux; uy; uz];

```

```
% Electric field computation
```

```
E = (ones(3,1)*(Q./(4*pi*EPS0*r.^2))).*uVec;  
Etot = sum(E,2);  
Emag = vectorMag(Etot);  
Euv = (Etot/Emag)';
```

```
%Output
```

```
fprintf('Magnitude of resultant field at point P is %f mV/m.\n',Emag*1000 );  
disp('Unit vector of resultant force :');  
disp(Euv);
```

```
figure(1);  
plot3(0,0,0,'k');  
hold on;  
for i=1:N  
plot3(x(i),y(i),z(i),'o','MarkerSize',10,'MarkerFaceColor','b');  
line([xp , x(i)],[yp,y(i)], [zp,z(i)], 'LineStyle',':');  
hold on;  
vecPlot3D([xp yp zp],[xp yp zp] + E(:,i)',1/Emag,'b',0);  
hold on;  
end;  
vecPlot3D([xp yp zp],[xp yp zp] + Etot',1/Emag,'r',0);  
text(1.1*xp,1.1*yp,1.1*zp,'Total electric field','Color','r');  
  
hold off;  
axis equal;  
xlabel('x');  
ylabel('y');  
zlabel('z');  
title({'Electric field due to ',int2str(N),'-point charges'});
```