MATLAB EXERCISE 1.29 **Equipotential lines for a small electric dipole.** Write a MATLAB program that displays the distribution of the electric potential due to an electric dipole (Fig.1.19 in the book) with a moment $\mathbf{p} = p\,\hat{\mathbf{z}}$ located at the origin of a spherical coordinate system. As output, the program provides two plots in the plane defined by $y = 0$ in the associated Cartesian coordinate system: one representing the potential by means of MATLAB function `pcolor` (that uses color to visualize the third dimension) and the other showing equipotential lines (cuts in a specific plane of equipotential surfaces, namely, surfaces having the same potential, $V = \text{const}$, at all points) with the help of MATLAB function `contour`. *(ME1_29.m on IR)*

SOLUTION:

The electric dipole potential is given by Eq.(1.42) (from the book), where, for $y = 0$, $\cos\theta = z/r$ and $r = \sqrt{x^2 + z^2}$. Figures S1.15 and S1.16 show the resulting potential distribution and equipotential lines, respectively.

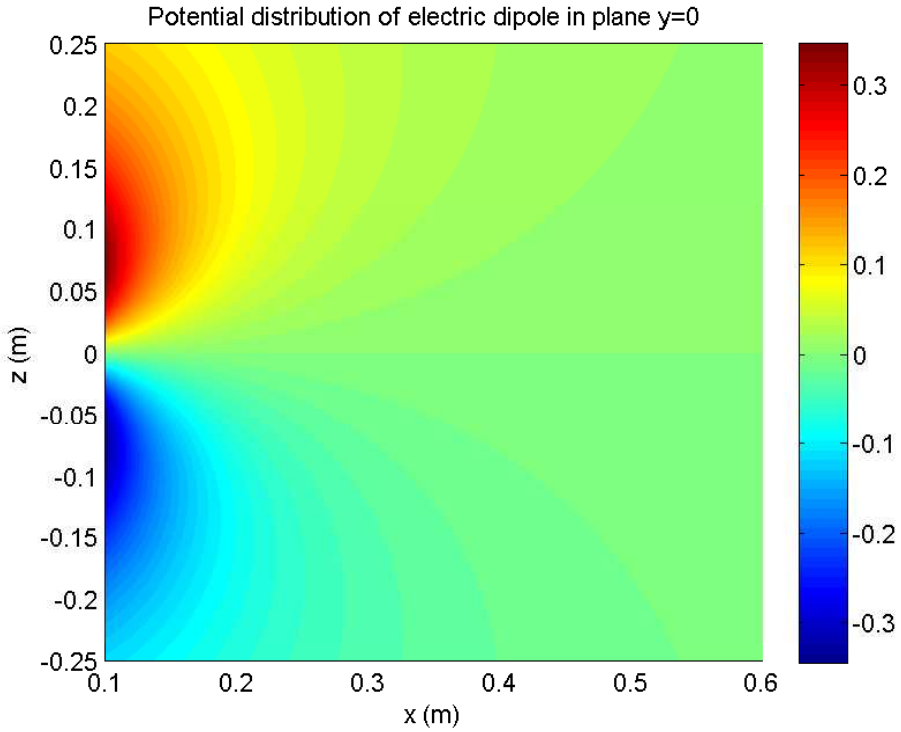

Figure S1.15 Potential distribution obtained by MATLAB function `pcolor` in the plane $y = 0$ for an electric dipole at the coordinate origin with $\mathbf{p} = 1$ pCm $\hat{\mathbf{z}}$; for MATLAB Exercise 1.29.

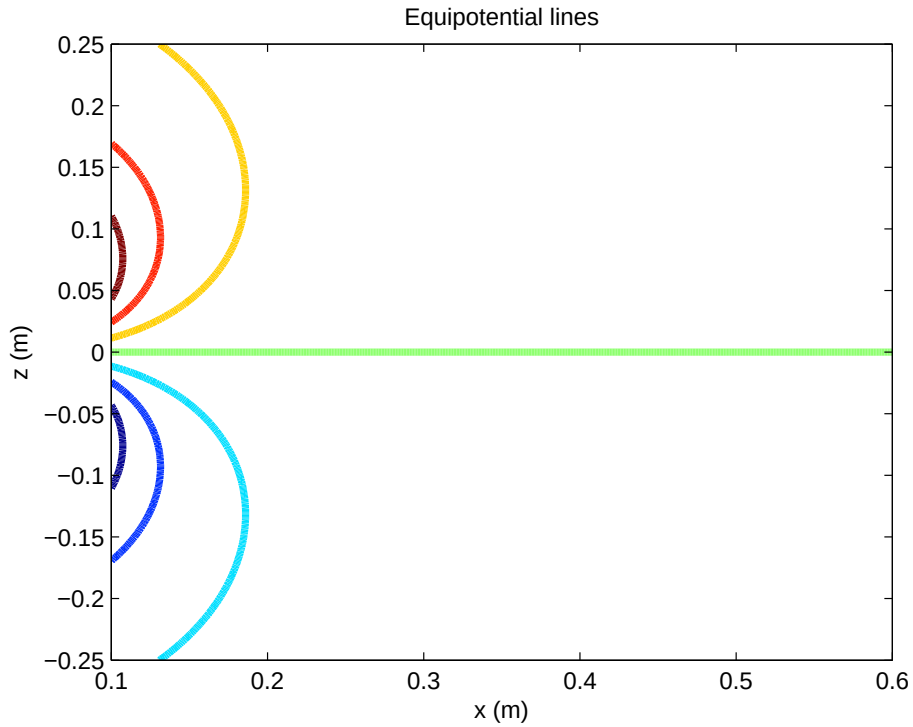

Figure S1.16 Equipotential lines obtained by MATLAB function `contour` in the plane $y = 0$ for the electric dipole; for MATLAB Exercise 1.29.

```
%
%   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
%
%
%


%   Equipotential lines for a small electric dipole


clear all;
close all;
EPS0 = 8.854e-12;
p = 1*10^(-12); %Moment of electric dipole (C m)
[x,z]=meshgrid(0.1:0.001:0.6, -0.25:0.001:0.25);
% Radial distance
r=sqrt(x.^2 + z.^2);
% Potential
V=p*(z./r)./(4*pi*EPS0*r.^2);
figure (1);
pcolor(x,z,V);
xlabel('x (m)');
ylabel('z (m)');
title('Potential distribution of electric dipole in plane y=0');
shading interp;
colorbar;
figure(2);
contour(x,z,V,'linewidth',3);
xlabel('x (m)');
ylabel('z (m)');
title('Equipotential lines');
```