# Antenna Assignment

1) A center-fed Hertzian dipole is excited by a current $I_0$ = 20 A. If the dipole is l /50 in length, determine the maximum radiated power density at a distance of 1 km.
2) A 1-m–long dipole is excited by a 1-MHz current with an amplitude of 12 A. What is the average power density radiated by the dipole at a distance of 5 km in a direction that is $45^\circ$ from the dipole axis?
3) Assume we have an isotropic antenna with EIRP of 5KW. The receiver is located 10 meters away form the transmitter. Find the following:
   a) Magnetic field strength at the receiving point
   b) Electric field strength at the receiving point
   c) Power density at the receiving point
   d) Draw E and H and show their direction at the receiving point
   e) Calculate the free space impedance for the given values

4) For a given a half-wave Dipole find the following parameters (HINT: Use the Applet to check your answers – check the slides; start with the expressions for E and H filed strengths):

   a) Average power density
   b) Power Density (Smax)
   c) Normalized radiation intensity, F
   d) Directionality, D (from the table)
   e) P_radiated
   f) R_radiated
   g) Prove that 3dB BW is actually 78 degrees (you can use substitution to prove!)
   h) HINT: Use the applet to check your answers

4) Complete the following table based on the results you obtained above and the results we discussed in the class:

| Antenna | Gt=D | Rrad | Prad | 3dB BW | Eff. Area |
|---|---|---|---|---|---|
| Short Dipole | | | | | |
| ½ Wave | | | | | |

5) The general pattern function for a given dipole is defined as follow: $$F(\theta) = \frac{\cos\left(\frac{kl}{2}\cos\theta\right) - \cos\left(\frac{kl}{2}\right)}{\sin\theta}$$

Using the following Matlab code it is possible to plot the 3D radiation pattern of an antenna. In order to do that it is required to change the `radio` function in the code and define the exact relationship between the length of the dipole and the wavelength, e.g., `len` value in the code. Answer the following questions:

a) Show that the given pattern function can be reduced to your answer in Part C of Question 4 above: Normalized radiation intensity, F.

b) Plot the radiation pattern for a half-wavelength dipole.

c) Plot the radiation patterns for a quarter-wavelength dipole.

d) Compare the differences in radiation patterns for ¼ - and ½- wavelength dipoles.

```
len = 1/8; % of lambda
k=2*pi;
n_tehta = 130; % Samples on Elevation
n_phi = 130; % Samples on Azimut
[tehta,phi]=meshgrid(eps:pi./(n_tehta-1):pi,...
            0:2*pi./(n_phi-1):2*pi) ;
radio = %%% YOU FUNCTION IS HERE! %%%%;
X=radio.*sin(tehta).*cos(phi);
Y=radio.*sin(tehta).*sin(phi);
Z=radio.*cos(tehta);
surf(X,Y,Z)
camlight right
light
shading interp
colorbar
axis image
TITLE('3D-Pattern plot')
```