**ASSIGNMENT 10**

(due Thursday December 8, 2022)

1. (50 points) Optimize a dipole antenna made of copper using *FEKO* with the following impedance specifications: $R_{in} = 73\ \Omega$ and $X_{in} = 0\ \Omega$ at $f = 30$ MHz. Use *FEKO*'s *Simplex Search* method. The parameter to be optimized is the dipole length *L*. The radius of the dipole arm is *a* = 1 cm. State how you formulated the objective (or cost) function. Illustrate the progress of the optimization process by plotting the dipole length *L* vs. iterations and the objective function versus iterations. Report the following parameters of the optimum design:

**(a)** the dipole length $L^*$,
**(b)** the input impedance $Z_{in}(L^*) = R_{in} + jX_{in}$,
**(c)** the radiation efficiency $e_A(L^*)$,
**(d)** the maximum directivity $D_0(L^*)$,
**(e)** the polarization, and
**(f)** the 2-D polar plots of the gain pattern in the two principal planes, all at 30 MHz.

Then, simulate your optimal design in the frequency band from 29 MHz to 31 MHz with a step of 0.1 MHz and provide plots illustrating:

**(i)** the real and the imaginary parts of the impedance vs. frequency,
**(ii)** the efficiency vs. frequency, and
**(iii)** the maximum gain vs. frequency.

2. (25 points) Calculate the input impedance (real and imaginary parts) of a dipole of length $L^*$ (found in Problem #1) and radius *a* using the EMF method at 30 MHz. Compare the results with the simulation.

3. (25 points) Calculate analytically the loss resistance $R_l$ of the copper dipole of length $L^*$ and radius *a* at 30 MHz assuming sinusoidal current distribution along the dipole (see Lecture 4 if in doubt). Calculate the radiation resistance $R_r$ using the input resistance $R_{in}$ as computed from the EMF method and assuming sinusoidal current distribution (see Lecture 9 if in doubt). From $R_l$ and $R_r$ calculate the radiation efficiency $e_A$ of the dipole and compare the value with the simulated one.