PHYS 942 homework assignment #05

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PHYS 942
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Names ($\leq$3, write clearly): _____

Due: Monday, November 5, 2018, at the lecture. **Show all your steps!**

1. (*10 points*) A FM radio station emits 100 kW through a vertical dipole antenna at 90 MHz. What is the peak-to-peak electric field of the emitted waves 30 km away?

2. (*40 points*) Consider a rotating charge distribution $\rho(\mathbf{x}, t) = \rho(r, \theta, \phi - \omega t)$, where ω is the rotation frequency.

   (a) Expand $\rho(\mathbf{x}, t)$ into a Fourier series in time. Show that

   $$\rho(\mathbf{x}, t) = \rho_0(\mathbf{x}) + \sum_{n=1}^{\infty} \mathrm{Re}[2\rho_n(\mathbf{x}) e^{-in\omega t}]$$

   and determine $\rho_n(\mathbf{x})$.

   (b) From (a), calculate the Cartesian multipole moments up to the quadrupole for a single charge q rotating around the z axis at distance R with frequency ω.

   (c) At which frequencies does the rotating charge radiate?

3. (*40 points*) Zangwill, problem 20.1.