Homework Set No. 6, Physics 835

Deadline – Friday, March 7, 2008

1. (10 pts) A wire of radius d carrying current I is rotated about its diameter with constant angular velocity ω. Calculate the time-averaged radiated power per unit solid angle far away from the wire in the small-loop approximation $k\,d \ll 1$. What is the total radiated power? (Hint: it's the magnetic dipole moment radiation.)

2. (10 pts) Prove that the operator multiplying Y_{lm} on the left hand side of Eq. (9.99) in Jackson is equal to $\vec{L}^2$, with $\vec{L}$ defined in Eq. (9.101) of Jackson.

3. (10 pts) Jackson Problem 10.1 (a,b)

4. (10 pts) Jackson Problem 10.4 (Hint: use dielectric function

$$\epsilon = \epsilon_r + \frac{i\,\sigma}{\omega\,\epsilon_0} \tag{1}$$

in previously derived cross section. Absorption cross section can be calculated by using the definition of P_{abs} in terms of Poynting vector and employing Jackson's Eq. (6.108) and Ohm's law.)

5. (10 pts) Jackson Problem 10.11 (a,b), where Fresnel integrals are defined by

$$C(\xi) = \sqrt{\frac{2}{\pi}} \int_0^\xi \cos\eta^2 \, d\eta \tag{2}$$

$$S(\xi) = \sqrt{\frac{2}{\pi}} \int_0^\xi \sin\eta^2 \, d\eta. \tag{3}$$

In part (b) a numerical plot of $I(X)$ would suffice, though you may do what Jackson requires for a full credit as well. Finally, a hint:

$$\int_{-\infty}^{\infty} dy\, e^{i\,y^2} = \sqrt{\frac{\pi}{2}}\,(1+i). \tag{4}$$

Can you prove this?