1. (10 pts) A wire of radius $d$ carrying current $I$ is rotated about its diameter with constant angular velocity $\omega$. Calculate the time-averaged radiated power per unit solid angle far away from the wire in the small-loop approximation $kd \ll 1$. 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

\[ \epsilon = \epsilon_r + \frac{i \sigma}{\omega \epsilon_0} \]  (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

\[ C(\xi) = \sqrt{\frac{2}{\pi}} \int_0^\xi \cos \eta^2 d\eta \]  (2)

\[ S(\xi) = \sqrt{\frac{2}{\pi}} \int_0^\xi \sin \eta^2 d\eta. \]  (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:

\[ \int_{-\infty}^{\infty} dy e^{iy^2} = \sqrt{\frac{\pi}{2}} (1 + i). \]  (4)

Can you prove this?