DUE: TUESDAY, FEBRUARY 20, 2024

MIDTERM ALERT: The midterm exam will be posted on the class website after class on Tuesday February 20 and will be due in class Thursday February 22.

While working on the exam, you may refer to Jackson's text and any second electromagnetic textbook of your choosing. (If you do consult a second text, please indicate which one you used.) Any reference for integrals or other mathematical facts, and any personal handwritten notes and/or the posted lecture notes are also OK. You are also free to consult any of the material posted on the class website. However, you may *not* collaborate with anyone else. The exam will cover material from Chapters 8, 9 and 11 of Jackson (and the first three problem sets of this course).

1. Jackson, problem 9.2

HINT: Show that the time-dependent quadrupole tensor can be written as the real part of a complex tensor of the form $Q_{ij}(t) = Q_{ij}e^{-2i\omega t}$, where Q_{ij} is a a complex matrix that depends on a and q. Note the factor of 2 in the exponent. How does this affect the application of the formulas for $dP/d\Omega$ and P given in section 9.3 of Jackson?

2. (a) Jackson, problem 9.6

   (b) Using the results of part (a), solve Jackson, problem 9.7(a).

3. Jackson, problem 9.8

HINT: To answer part (b), consider the case where only one of the three components of the electric dipole moment in a spherical basis, q_{1m}, is nonzero. See eqs. (4.5) and (4.7) of Jackson for the relations between $\vec{\boldsymbol{p}}$ and the q_{1m}. Consider separately the cases of $m = -1, 0$ and $+1$. Determine how the ratio of angular momentum radiated to energy radiated depends on m.

4. Jackson, problem 9.16

NOTE: Do *not* employ any approximations associated with the multipole expansion in this problem.