Physics 504 Project #2
Due: Thursday, February 24, 2009

Note: This project is to be worked on in groups:
Group 1: Dai, Shams, Tourani, Zhang
Group 2: Basirnia, Flynn, Guan, Hovey
Group 3: Edrey, Gao, Hassan, Naudus
Group 4: Jones, Kaplan, Liu, Meyerson
Group 5: Hogan, Park, Patel, Seitz

Each group should meet soon to lay out the steps necessary to complete the project, and divide up the work. Unlike ordinary homework, where though communication is encouraged, each individual is expected to work through all parts him/her-self, in a project it is acceptible for each member to have only read through and understood each part, without actually having worked through each part individually.

The project is to be written up consistently, coherently, and neatly, preferably on a computer, even more preferably in TEX or LATEX. Each member is responsible for proofreading before submission.

The project uses generalized curvilinear coordinates in two problems.

A) A charged conductor in the shape of an oblate ellipsoid,

$$\left(\frac{x}{A}\right)^2 + \left(\frac{y}{A}\right)^2 + \left(\frac{z}{B}\right)^2 = 1,$$

with $A > B$, sits in otherwise empty space. Find the electrostatic potential everywhere outside the conductor, assuming $\Phi = V_0$ on the conducting surface. This is to be done analytically, using the appropriate generalized coordinates.

From this general case, take the limit $B \to 0$. From the large distance limit of the potential, extract the net charge on the conductor, and hence find the capacitance of a thin disk of radius a.

B) Two straight parallel circular-cylindrical conductors, each of radius R, with their centers separated by a distance $2L$. The dominant mode is the TEM mode. Note the fields in question are em outside the conductors. Find the impediance if $R = 0.500$ mm and $2L = 8.00$ mm, as is approximately true for the "300 Ω" television cable I displayed in class. [Note: this is not the "wave impediance" from page 359.]

These are to be worked analytically as far as possible, and final numerical answers good to at least three decimal places.
You may find these keywords useful: ellipsoidal coordinates; bipolar coordinates.