PHYS 621 – FINAL EXAM (TAKE-HOME PART)

DUE WED, DEC. 9, 2009 at 9:00 AM in Lewis Hall 228

Solve all three problems. Each problem counts 10 points (10%) towards your final grade.

PLEASE write neatly and in a legible way. Solutions difficult to read or not neatly written will **NOT** be graded and will count zero points. Show all the steps and calculations to get full credit. A result which is derived without sufficient details or explanations will count zero points even if it is correct.

Write your name on all pages, staple them and return this sheet with them. Please feel free to email me (cavaglia@phy.olemiss.edu) if anything is unclear.

NOTE: Failure to appear at the final exam time and location posted above (Wednesday, December 9th, 2009 at 9:00 a.m. in Lewis Hall 228) will result in a fail grade.

Problem 1: A very long conducting cylinder of radius a is divided into four $90°$ sectors by thin insulating plates passing through the axis. The sectors are at potentials $+V$, $-V$, $+V$ and $-V$, respectively.

a) Compute the potential inside and outside the cylinder;

b) Compute the potential inside the cylinder if a wire of charge per unit length λ is added along the axis of the cylinder.

Problem 2: A grounded conducting sphere of radius a is surrounded by a concentric spherical shell of dielectric material of inner radius a, outer radius b, and dielectric constant ϵ. Suppose that the sphere and the dielectric shell are placed in an initially uniform electric field $\mathbf{E}_0$.

a) Compute the potential inside and outside the spherical shell;

b) Find the free surface charge density and the total charge induced on the surface of the conducting sphere;

c) Find the bound charge density induced on the surface of the dielectric at $r = a$ and $r = b$.

Problem 3: A disk of paper of radius a carries a charge Q uniformly distributed over its surface. The disk spins about its axis at angular velocity ω.

a) Find the magnetic field at distance $r > a$ from the center of the disk;

b) Compute the force experienced by an infinitely long straight wire parallel to the axis of the disk and located at a distance $d \gg a$ from the center of the latter if the wire carries a steady current I.