Physics 503 Final Exam
Fall 2012

You may use your copy of Jackson as well as the set of notes that we have generated as a class, any noted you have taken individually, solutions from homework problems, and your favorite mathematical reference book. Return this exam to me by Friday, 21 December 2012.
1. Jackson problem 7.3

Two Plane semi-infinite slabs of the same uniform, isotropic, nonpermeable, lossless dielectric with index of refraction $n$ are parallel and separated by an air gap ($n = 1$) of width $d$. A plane electromagnetic wave of frequency $\omega$ is incident on the gap from one of the slabs with angle of incidence $\theta_i$. For linear polarization both parallel to and perpendicular to the plane of incidence,

(a) calculate the ratio of power transmitted into the second slab to the incident power and the ratio of reflected to incident power;

(b) for $\theta_i$ greater than the critical angle for total internal reflection, sketch the ratio of transmitted power to incident power as a function of $d$ measured in units of wavelength in the gap.

2. Jackson problem 5.6

A cylindrical conductor of radius $a$ has a hole of radius $b$ bored parallel to, and centered a distance $d$ from, the cylinder axis ($d + b < a$). The current density is uniform throughout the remaining metal of the cylinder and is parallel to the axis. Use Amperé’s law and principle of linear superposition to find the magnitude and direction of the magnetic-flux density in the hole.

3. Jackson problem 3.14

A line charge of length $2d$ with a total charge $Q$ has a linear charge density varying as $(d^2 - z^2)$, where $z$ is the distance from the midpoint. A grounded, conducting, spherical shell of inner radius $b > d$ is centered at the midpoint of the line charge.

(a) Find the potential everywhere inside the spherical shell as an expansion in Legendre polynomials.

(b) Calculate the surface-charge density induced on the shell.

(c) Discuss your answer to parts a and b in the limit that $d << b$.

4. Griffiths problem 6.18

A sphere of linear magnetic material is placed in an otherwise uniform magnetic field $B_0$. Find the new field inside the sphere.