3/17/2005. **Due:** Thursday, March 31, 2005 (in class).

# Physics 302/572: Electromagnetic Theory II

**Read: Griffiths** 9.5, 10.1

"**G**, **PS**" refer to Griffiths and Pollack & Stump books respectively.
Problems with stars are not for credit and will NOT be graded.

# Homework 6

## Exercise 1 (G 9.29)

Confirm that the energy in the $\mathrm{TE}_{mn}$ mode travels at the group velocity.

*Hint*: Using $E$ and $B$ for the mode find the time averaged Poynting vector $\langle \vec{S} \rangle$ and the energy density $\langle u \rangle$. Integrate over the cross section of the wave guide to get the energy per unit time and per unit length carried by the wave, and take their ratio.

## Exercise 2 (G 10.3)

Find the fields, and the charge and current distributions, corresponding to

$$V(\vec{r},t) = 0, \quad \vec{A}(\vec{r},t) = -\frac{1}{4\pi\epsilon_0}\frac{qt}{r^2}\hat{r}.$$

Are these potentials in the Lorentz or/and in the Coulomb gauge?

## Exercise 3 (G 10.5)

Use the gauge function $\lambda = -\frac{1}{4\pi\epsilon_0}\frac{qt}{r}$ to transform the potentials in Ex. 2, and comment on the result. Are resulting potentials in the Lorentz or/and in the Coulomb gauge?

## Exercise 4 (G 10.4)

Suppose $V = 0$ and $\vec{A} = A_0 \sin(kx - \omega t)\hat{y}$, where $A_0$, $\omega$, and $k$ are constants. Find $\vec{E}$ and $\vec{B}$, and check that they satisfy Maxwell's equations in vacuum. What condition must you impose on $\omega$ and $k$? Are these potentials in the Lorentz or/and in the Coulomb gauge?