**Phys 375 - Prof. Hall**
**Homework #5, due October 27&28, 2008**

1) Pedrotti, problem 8-1.

2) Pedrotti, problem 8-3.

3) Pedrotti, problem 8-5.

4) In the second half of the nineteenth century it was assumed that the speed of propagation of light waves depends on the frame of reference in which the waves are observed. In 1887, Michelson and Morley performed a famous experiment at the Case Institute (now Case Western University) in Cleveland, OH. Using a Michelson interferometer, they hoped to detect the motion of the earth through space by observing the small change in the velocity of light that would occur due to the earth's motion.

Imagine that a Michelson interferometer is oriented so that one arm points in the direction of earth's motion around the sun, and that the other arm is transverse to the earth's motion. The interferometer is illuminated with a He-Ne laser, with wavelength 633 nm, and the length of each arm is one meter. Six hours later, both arms are perpendicular to the earth's motion, because the earth has rotated.

If we assume that the speed of light for motion parallel to the earth's velocity is $c + v_e$, and the speed of light perpendicular to the earth's motion is simply c, how many fringes should be observed to pass by a detector during the six hours that it takes the earth to rotate from the first configuration to the second? c is the speed of light in vacuum = $3.0 \times 10^8$ m/s, and $v_e$ is the Earth's orbital velocity around the sun = $3.0 \times 10^4$ m/s.

In practice no fringe shift is seen because the velocity of light is independent of the frame of reference, which is a basic prediction of the special theory of relativity. Today the Michelson-Morley experiment is considered to be the first experimental evidence for relativity.