Preparation Assignment Due Oct. 10, 2000

Fields and Waves I

1. Name 3 common devices that rely on Farraday's law for their operation.

2. A current transformer is a toroid with a uniform winding. Assume the major radius is R and the minor radius is a. If there are N turns on the toriod what is the emf if we pass I Amperes through the toroid? Is there an emf due to currents outside the toriod? Explain.

Preparation Assignment - Due October 11, 2000

1. A train is traveling at 100 km/hr along a track whose rails are 2 m apart. The vertical component of the earth's magnetic field is about .5 Gauss. Find the emf across the track.

2. One strategy for maglev trains is to have a large magnet on the train and an aluminum (good conductor) plate under the train. As the train travels along the plate a voltage is induced in the plate and currents flow which lift the train. Why do they lift (push) rather than attract the train?

Homework 5, Fields and Waves I

Due October 12, 2000

1. A coil is formed by winding N=10 turns of wire into a loop of radius $a = 10\ cm$. The loop is in the $x-y$ plane with center at the origin. The loop is closed with a resistor of value $R = 5\ \Omega$. There is a magnetic flux density given by $B = 0.2 * (2\hat{a}_y + 3\hat{a}_z) \sin 1000t\ T$.

a) Find the flux linking the winding.

b) Find the EMF of the winding.

c) Find the current in the winding.

2. A rectangular loop of wire is located in the $x-y$ plane. Two sides are parallel to the x axis and are 2 m long. The two sides parallel to the y axis are 0.5 m long. The total resistance of the wire is 5 Ω and we can ignore the inductance. There is a magnetic field given by $B = 0.2e^{-0.1y}\hat{a}_z\ T$. The loop is moving at velocity $u = 5\hat{a}_y\ m/s$. At the instant that the 2 sides of the loop are at $y_1 = 2\ m$ and $y = 2.5\ m$

a) Find the flux linkage of the loop

b) Find the current in the loop.

c) How much force is required to keep the coil moving?

d) How much mechanical power is being put into the system.

e) How much power is dissipated in the resistance?

f) Comment on the results of parts (d) and (e).

3. A circuit is shown in Figure 3, where a magnetic field $B = 2 \sin 377t$ links the circuit. There is no flux outside the circuit. What are the readings of the 3 ideal voltmeters?

4. In Figure 4, a swinging bar generator has horizontal harmonic motion with velocity $u = \omega r \cos \omega t$. The ac current in the winding produces a uniform magnetic field in the air gap of $B = B_0 \cos \omega t$. Find the induced voltage in the bar.