Electromagnetics 1 final exam. (Prof. Seong-cheol, Kim)

12th June 2008, PM 12:30 ~ PM 2:30

1. For the small rectangular loop with sides a and b that carries a current I, shown in Figure 1.

(a) Find the vector magnetic potential $\overline{A}$ at a distant point, P(x, y, z). Show that it can be put in the form of $\overline{A}=\frac{\mu_0 \overline{m}\times\hat{R}}{4\pi R^2}$.

(b) Determine the magnetic flux density $\overline{B}$ from $\overline{A}$, and show that it is the same as that given in $\overline{B}=\frac{\mu_0 m}{4\pi R^3}(\hat{R}2\cos\theta+\hat{\theta}\sin\theta)$.

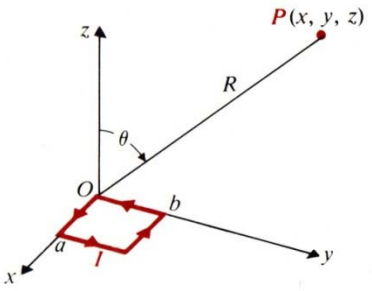

Figure 1.

2. Calculate the mutual inductance per unit length between two parallel two-wire transmission lines A-A' and B-B' separated by a distance D, as shown in Figure 2. Assume the wire radius to be much smaller than D and the wire spacing d.

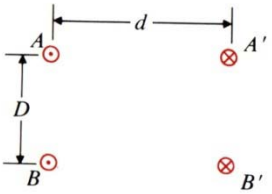

Figure. 2

3. A rectangular metal strip of width 10 (cm) is moving parallel to the xy plane with a constant velocity of $\overline{u}$ = -1000a_y (m/s), as shown in Figure 3. If a magnetic flux density of $\overline{B}$ = 0.2a_z exists in the region, determine the reading on the voltmeter.

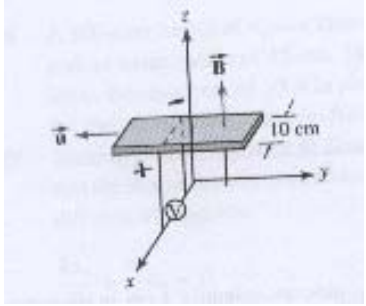

Figure 3.

4. A proton is revolving in a uniform magnetic field of $1.75a_z$ with a velocity of $3000a_z - 4000a_\phi$. Determine

(a) the force acting on the proton ($q = 1.6\times10^{-19}$)

(b) the direction of rotation

(c) the radius of the orbit (centripetal force F = $\frac{mv^2}{r}$)

(d) the time period

(e) the cyclotron frequency

(f) the pitch of the helix.

5. A wave propagating along a transmission line is represented by the following equation. $V^+(z,t) = 10W(10^9 t - 5z)$.

where W(x) is the pulse function as shown Figure 4.

(a) Find the velocity of propagation.

(b) Sketch the variation of the voltage $V^+(z,t)$ with z for t = -1, 0, 1, 5 μs.

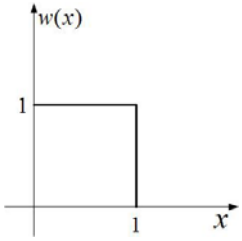

Figure 4.

6. Discuss the boundary conditions for time varying electromagnetic fields. as much as you can.

(point) : 1.(20) 2.(20) 3.(20) 4.(20) 5.(10) 6.(10) Good luck!