كهرباء أولى - قديم - نظرية مجالات (١) أ.د. أكرم التوني "وم واحد" مرفقان

Mansoura University
Faculty of Engineering
Electrical Eng. Dept.

Electromagnetics (1)
Time allowed: 90 minutes
التخلفات

Final Exam., July 2011

Second Part

➢ Please Attempt ALL Questions

Fourth Question

(a) At time t=0 a lossy dielectric sphere has 5mC of charge uniformly distributed throughout its interior. The sphere has a diameter of 3 cm and constitutive parameters $\varepsilon = 10\varepsilon_0$ and $\sigma = 1$S/m. For all t, find (i) the current density J inside and outside the sphere and (ii)the electric field E inside and outside the sphere.

(b) An infinite sheet is located in the X-Y plane and centred around the origin. The sheet has a surface current density $\mathbf{J_S} = J_0\,\mathbf{a_y}$. Determine the magnetic flux density at a point on the z-axis.

Fifth Question

(a) A small circular loop of radius a is carrying a direct current of I Amperes. The loop lies in the X-Y plane and is centred around the origin. **Use the magnetic vector potential** approach to compute the magnetic flux density (B) produced by the loop at some point in the space.

(b) Suppose a time-varying magnetic field is defined in space in a cylindrical coordinate system as $\mathbf{B} = \begin{cases} B_0 \sin\omega t\ \mathbf{a}_z & r \le r_0 \\ 0 & r > r_0 \end{cases}$

Determine the induced electric field via Faraday's law.

Sixth Question

(a) Two coaxial filaments of constant current are shown in Fig.1. Determine the magnetic flux density at some point on the z axis above the second filament.

(b) The electric and magnetic fields in free space in a spherical coordinate system are:

$$\mathbf{E} = \frac{12}{r}\sin\theta\cos(\omega t - \frac{4\pi}{3}r)\ \mathbf{a}_\theta \quad \text{V/m}, \quad \mathbf{H} = \frac{18}{140\,\pi r}\sin\theta\cos(\omega t - \frac{4\pi}{3}r)\ \mathbf{a}_\phi \quad \text{A/m}$$

Determine the Poynting vector. What is the direction of power flow?. Calculate the total time-average power leaving the spherical closed regions of radius 170m and 10Km.

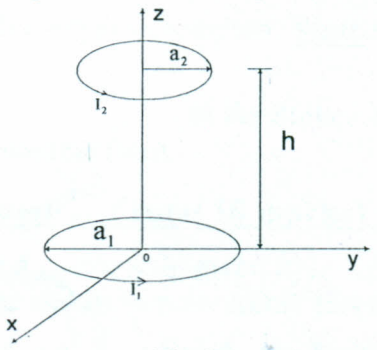

Fig.1

good luck