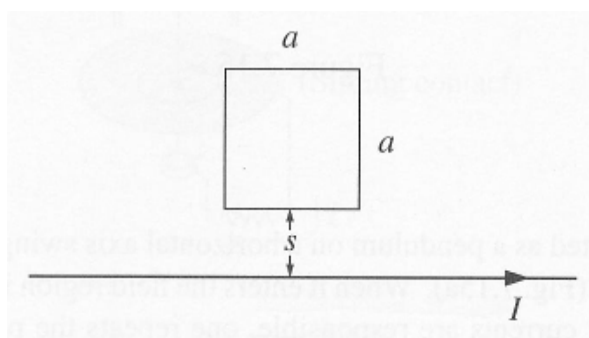


國立嘉義大學九十六學年度

光電暨固態電子研究所碩士班招生考試（乙組）試題

科目：電磁學

1. (a) Find the capacitance of a parallel-plate capacitor consisting of two metal surfaces held a distance d apart. The two metal surfaces carry charges $+Q$ and $-Q$, respectively. (b) Find the capacitance of two concentric spherical metal shells, with radii a and b . (20%)
2. A sphere of homogeneous linear dielectric material, with material of dielectric constant ϵ_r , is placed in a uniform electric field \mathbf{E}_0 . Find the electric field inside the sphere. (20%).
3. A square loop of wire (side a) lies on a table, a distance s from a very long straight wire, which carries a current I , as shown in the figure below.



- (a) Find the flux of \mathbf{B} through the loop. (10%)
- (b) If someone now pulls the loop directly away from the wire, at speed v , what emf is generated? In what direction (clockwise or counterclockwise) does the current flow? (10%)
4. The electric field of an electromagnetic plane wave $\mathbf{E}(z,t) = E_0 \cos(kz - \omega t + \delta) \hat{x}$ and the magnetic field $\mathbf{B}(z,t) = (E_0/c) \cos(kz - \omega t + \delta) \hat{y}$, calculate the time averaged (a) energy density $\langle u \rangle$ (b) Poynting vector $\langle \mathbf{S} \rangle$ (c) momentum density $\langle \mathcal{P}_{em} \rangle$ and (d) radiation pressure P (e) intensity I . (20%)
5. The electric field of a \mathbf{x} linearly polarized plane wave propagating in the $+z$ - direction in seawater is $\mathbf{E} = \mathbf{x} 100 \cos(10^7 \pi t)$ (V/m) at $z = 0$. The constitutive parameters of seawater are dielectric constant $\epsilon_r = 72$, relative permeability $\mu_r = 1$, and conductivity $\sigma = 4$ (S/m). (a) Determine the attenuation constant, phase constant, intrinsic impedance, phase velocity, and skin depth. (b) Find the distance at which the amplitude of \mathbf{E} is 1 % of its value at $z = 0$. (c) Write the expressions for $\mathbf{E}(z, t)$ and $\mathbf{H}(z, t)$ at $z = 0.8$ m as functions of t . (20%)