國立中山大學 112 學年度
碩士班暨碩士在職專班招生考試試題

科目名稱：電磁學【電機系碩士班戊組、通訊所碩士班乙組、電波聯合碩士班】

1. (25%) The length of a coaxial cable with outer and inner conductors is L. The space between the outer conductor of inner radius a and the inner conductor of radius b is filled by a medium with permittivity ϵ and conductivity σ. The leakage resistance between these two conductors is R and the capacitance of this cable is C. Determine RC.

2. (25%) The rectangular and circular loops are coplanar as shown in Fig. 1. The radius of the circular loop is c. Determine the mutual inductance between these two loops. Assume that b >> c and c > d.
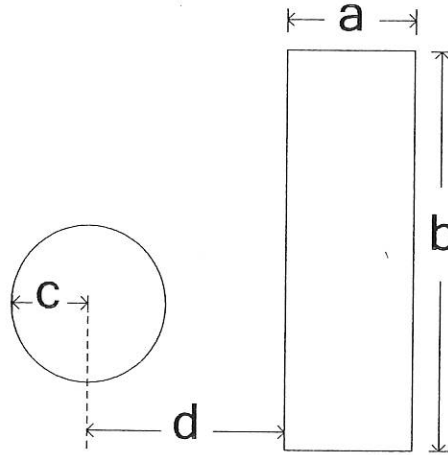

Fig. 1

3. (5%) (a) Write Maxwell's equations in differential form.
   (5%) (b) Write the EM boundary conditions.
   (5%) (c) Explain homogeneous Helmholtz's equation.
   (5%) (d) Explain dispersion.

4. As shown in Fig. 2, a uniform plane wave ($\mathbf{E}_i$, $\mathbf{H}_i$) of an angular frequency ω is incident from air on a very large, perfectly conducting wall at an angle of incidence θ_i with perpendicular polarization. Find
   (5%) (a) the current induced on the wall surface, and
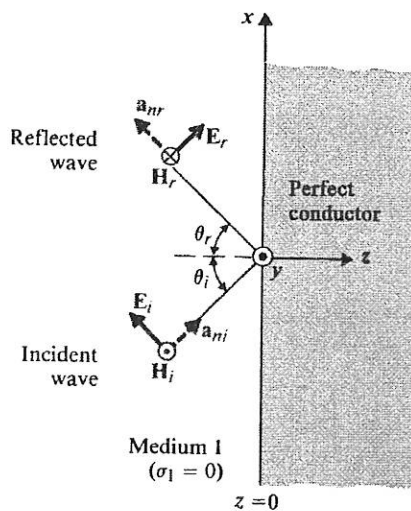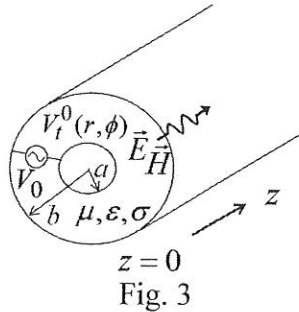   (5%) (b) the time-average Poynting vector in medium 1.

Fig. 2

5. (10%) As shown in Fig. 3, for a coaxial line in TEM mode, find **E** and **H**.

Fig. 3

6. The open-circuit and short-circuit impedance at the input terminals of a lossless transmission line of length 1.5 (m), which is less than a quarter wavelength, are $-j54.6$ (Ω) and $j103$ (Ω), respectively.

(4%) Find Z_0 and γ of the line.

(4%) Without changing the operating frequency, find the input impedance of a short-circuited line that is twice the given length.

(2%) How long should the short-circuited line be in order for it to appear as an open circuit at the input terminals?