

國立臺灣科技大學  
九十三學年度碩士班考試試題

系所組別：電子工程系乙三組、電子工程系丙組  
科 目：電磁學

- 總分 100 分
- 1) A long parallel-wire transmission line has a length  $L$ . It has circular conducting wires of radius  $b$ . The axes of the wires are separated by a distance  $D$ ,  $L \gg D \gg b$ . The space between these wires is filled with a lossy dielectric of conductivity  $\sigma$ , permittivity  $\epsilon$ , permeability  $\mu$ , and dielectric strength  $E_c$ . (A) Find the **capacitance** of the transmission line. (B) Find the **leakage resistance** between the wires. (C) Ignoring the conductivity  $\sigma$ , find the **maximum voltage** that can be applied to the transmission line without a breakdown. [8%+8%+8%]
- 2) (A) From Maxwell's equations, derive the boundary conditions for the normal components of the **time-varying** electric field intensity  $E$  and the tangential components of the **time-varying** magnetic field intensity  $H$ . Denote the field components normal to the interface between two media as  $E_n$  and  $H_n$ , the components tangential to the interface as  $E_t$  and  $H_t$ . (B) Consider the interface between a nonconducting medium and a conductor. Discuss and compare the magnitudes of  $E_n$ ,  $H_n$ ,  $E_t$ , and  $H_t$  **just outside** the conductor, if it is a **perfect** conductor. (C) Discuss and compare the magnitudes of  $E_n$  and  $H_t$  **just inside** the conductor, if it is a **good** conductor. [6%+4%+2%]
- 3) A thin, rectangular wire loop with a small gap is located in air near a long, straight wire carrying a current  $I = I_0 \cos(\omega t)$  at the frequency  $\omega$  at time  $t$ . The loop has a width  $b$ , a height  $c$ , and a distance  $s$  from the straight wire, as shown in Figure Prob\_3. If the loop moves away from the wire with a constant velocity  $U$  in the direction of increasing  $s$ , find the **voltage**  $V$  induced across the gap and discuss the effects of the magnitudes of loop dimensions and  $\omega$  on your result. [14%]

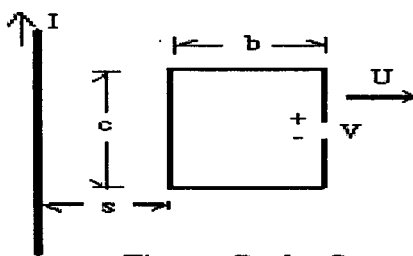


Figure Prob\_3



國立臺灣科技大學  
九十三學年度碩士班考試試題

系所組別：電子工程系乙三組、電子工程系丙組  
科 目：電磁學

4. A constant voltage  $V_0$  is applied to a partially filled parallel-plate capacitor shown in the Fig. prob4. The permittivity of the dielectric is  $\epsilon$ , and the area of the plates is  $S$ . Determine the force on the upper plate. (10%).

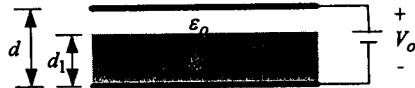


Fig. prob4

5. A air-dielectric lossless transmission line carrying a signal at  $f = 1\text{GHz}$  has a characteristic impedance of  $70\Omega$ . The line is just 0.5 meter of length and is terminated with a load of  $105 + j35\Omega$ .
- (a). Find the VSWR on the line. (5%)
- (b). Find the power delivered to the load if the generator is a voltage source  $V = 60 \cos 2\pi ft$  in series with an internal impedance  $Z_s = 60 + j38\Omega$ . (10%).
6. An infinite nonmagnetic material has the conductivity  $\sigma$ , permittivity  $\epsilon$  and permeability  $\mu_0$ . Find the attenuation constant  $\alpha$  and phase constant  $\beta$  for this medium. (10%)
7. Calculate the values of phase constant  $\beta$ , phase velocity  $v_p$ , group velocity  $u_g$ , wavelength  $\lambda_g$  and characteristic impedance  $Z_0$  for a  $2.5(\text{cm}) \times 1.5(\text{cm})$  rectangular waveguide operating at  $7.5\text{GHz}$  if the waveguide is filled with a dielectric medium characterized by  $\epsilon_r = 2, \mu_r = 1$  and  $\sigma = 0$ , and operates in the dominant mode  $\text{TE}_{10}$ . (15%)

