1. Assume that the region between the coaxial cylindrical conductors of Fig. 1 is filled with a dielectric of nonuniform permittivity $\varepsilon = \varepsilon_0 b / r$. Please obtain the solution for the potential between the conductors and the expression for the capacitance per unit length of the cylinders. (16%)

2. Charge Q is distributed with density proportional to r on a circular disk of radius a lying on the xy-plane with its center at the origin and rotating around the z-axis with angular velocity ω in the sense of increasing ϕ. Find the magnetic dipole moment. (20%)

3. A uniform plane wave is incident from air onto glass at an angle from the normal of 30 degree. Determine the fraction of the incident power that is reflected and transmitted for (a) TM polarization, with E filed in the plane of incidence; (b) TE polarization, with E filed perpendicular to the plane of incidence. (14%)

4. As shown in Fig.2, a lossless transmission line has a length of λ/2 and characteristic impedance of Z_0=60Ω. The source impedance is Z_S=50Ω and the load impedance is Z_L=40Ω. Due to the impedance mismatch, the power generated from the source is partially reflected and partially transmitted to the load. (35%)
   (1) Calculate the input impedance Z_{in}, reflection coefficient Γ_S, and VSWR (voltage standing wave ratio) at the source end of the transmission line.
   (2) Calculate the output impedance Z_{out} and reflection coefficient Γ_L at the load end of the transmission line.
   (3) If the amplitude of V_S is $1V$, calculate the time averaged power values of the input power P_{in} in the transmission line, the power P_{ref} reflected at the source end of the transmission line, and the power P_L transmitted to the load. Give your answers both in the units of mW and dBm. The time averaged power expression is given by $P_{av}=Re[VI^*]/2$, where V and I are phasors.
   (4) Give the condition to have the maximum value of the transmitted power P_L to the load, then calculate the maximum power value $P_{L,max}$.

5. Consider an air-filled parallel-copper-plate waveguide with its inner plate separation distance of $1.5cm$. The conductivity of copper is $\sigma = 5.8\times10^7 S/m$. (15%)
   (1) Calculate the cutoff frequencies of TEM, TE_1, and TM_1 modes.
   (2) Calculate the attenuation constant due to conductor loss for TEM, TE_1, and TM_1 modes at operating frequency of $5GHz$. Give your answers both in the units of *nepers/m* and *dB/m*.

見背面

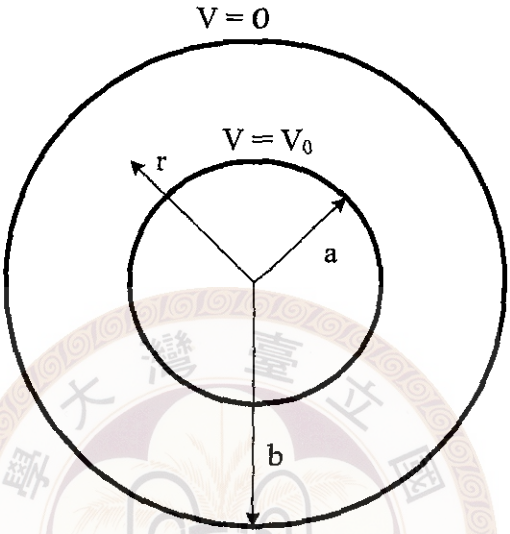

Fig. 1

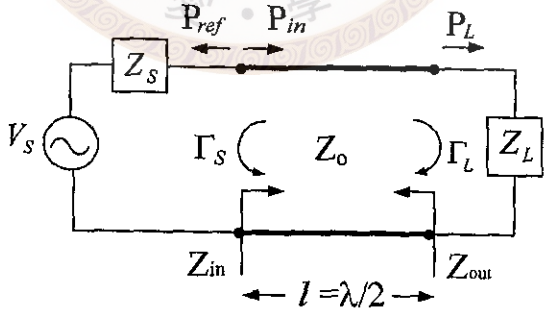

Fig. 2

試題隨卷繳回