National Sun Yat-sen University Institute of Electro-Optical Engineering
2003 PhD program-Entrance Examination

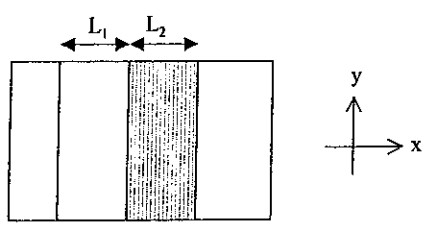
YOU MUST STATE YOUR ANSWER WITH REASONS.

1.[15%]
(a)Write down the Maxwell equations.
(b)Derive the wave equations from Maxwell equations.
(c)Please write down and explain the bound conditions between two non-magnetic and lossless dielectric materials with relative permittivities ε_1 and ε_2 respectively.
(d)What are boundary conditions if these two materials are conductive (σ_1 and σ_2)?

2. [15%]
In the time-harmonic situation, an optical plan-wave propagates in an isotropic medium with frequency f and relative permittivities ε. The electric field strength is E polarized at x-direction.
(a) Write down the formula describing the electric field of optical wave.
(b) Find the magnetic field in terms of electric fields.
(c) Find the wavelength and the velocity of the wave.
(d) If using phasor notation, ε is found to be complex. What are the physical meaning of real and imaginary parts of ε.

3. [20%]
(a)Please describe briefly how two parallel plates can transmit electromagnetic wave.
(b)Derive the wave equation describing the wave propagation in two parallel plates.
(c)Describe how you get the wave propagation constant and its characteristic impedance.
(d) What are the factors causing the wave propagation loss ? And it is frequency-dependent ? why ?

4. [30%]
As shown in figure, two adjacent materials (with ε_1 and ε_2, and thickness L_1 and L_2) are charged with negative charge density $\rho_1(x)$ and positive charge density $\rho_2(x)$ respectively, where the charge are uniformly distributed on y-z plane. The original point is set at the junction of two materials. The total charge for these two materials is neutral. State briefly for the following question.
(a) Please derive the electric field inside the material.
(b) If the charge density is constant, please find and plot the electric field in the inside and outside of charged regions.
(c) Continue the problem (b), find and plot the potential.
(d) Find the capacitance. You could set the region of $x<-L_1$ and $x>L_2$ to be conductive.



5. [20%]
Derive the inductance in a unit length of the coaxial cable at both cases shown below. Assume the radiuses of inner and outer conductors are **a** and **b**. The outer conductor is a perfect conductor. The dielectric between two conductors is lossless, nonmagnetic and the permittivity is ε.

(a) If the metal is perfect conductor, what is the inductance.
(b) If the current is uniformly distributed inside the inner conductor.