所別：電機工程學系碩士班 丁組 科目：電磁學

1. (11%) Is it possible to show the existence of light if there is no displacement current in the real world? Explain. (Hint: Maxwell's equations)

2. (22%) A plane wave is incident (from vacuum) upon a semi-infinite media of 99 different lossless dielectric slabs, all parallel to the surface of the media. The incident angle is θ_i from the normal of the surface. The permittivity and permeability of the i-th slab are denoted by ε_i and μ_i. Find the transmission angle θ_t in the 7th slab and 79th slab.

3. (20%) Assuming the conductor loss and dielectric loss are both zero. Determine the characteristic impedance of an off-center coaxial transmission line, where the inner wire of radius a_1 lies inside a conducting circular tunnel of radius a_2, and the distance between their axes is D.

4. Determine the cutoff frequency of dominant mode, and the wave impedance for following waveguide structures.
   (a) An air-filled $a \times b$ rectangular waveguide, where $a = b$ (4%).
   (b) An air-filled $a \times b$ rectangular waveguide, where $a = 2b$ (4%).
   (c) An infinite parallel-plate waveguide (4%)
   (d) Why TEM waves cannot exist in a single-conductor hollow waveguide? (1%)

5. The standing-wave ratio on a lossless 100-(Ω) transmission line terminated in an unknown load impedance is found to be 2. The distance between successive voltage maxima is 10(cm), and the first maximum is located at 7.5(cm) from the load. Determine (a) the reflection coefficient(10%) and (b) the load impedance(10%).

6. (14%) There is a coaxial cable. Assume that the radius of the inner conductor is 3mm, and insulating material is air, with dielectric strength $3 \times 10^6 V/m$. Determine the radius of the outer conductor so that the cable is to work safely at a voltage rating of 1.8kV. In order to avoid breakdown due to voltage surges caused by lightning and other abnormal external conditions, the maximum electric field intensity in the insulating material is not to exceed 20% of its dielectric strength.