國立中山大學九十三學年度博士班招生考試試題

科目：電磁學【光電所】

NSYSU, EIOE, 2004 Ph.D. Entrance Examination: EM Wave

1. Write down and explain the mathematical and physical meaning of four Maxwell equations. Give the formal names of E, H, D, B fields. Also explain why only two equations are needed for time-dependent EM waves i.e. show that for the time-dependent case, the two static equations can be derived from the two dynamic equations. (25%)

2. Optical waves in a 2-D medium are classified into two independent solution groups: namely a TE and a TM group. Assuming that both the geometry and the fields are invariant along the y-axis, compare the similarities and differences in the characteristic of these two groups (e.g. boundary conditions, propagation constants, mode field distribution, wave impedance, etc.) Illustrate you points for cases with weak and with strong index contrasts. (25%)

3. Derive the reflection and transmission formula for a slab of glass (of a length d, index n=1.5) in free space. You may assume for the normal incident case. You must show detail work to get full credit. (25%)

4. Dielectric waveguides are normally used to carry EM waves in the optical frequency whereas metallic rectangular waveguides are used for microwaves. The dielectric waveguides has a high-index core and a low-index cladding enclosing the core. The metallic waveguide is hollow inside filled with nothing but air. Both waveguides support low-attenuative guiding waves which are suitable for communication applications. Please compare the similarities and differences in the characteristic of these two waveguides in terms of the guiding principle, mode field confinement, mode polarization, mode classification, boundary conditions, propagation loss, waveguide dispersion and other relevant characteristics. Please draw a typical 2-D field plot showing the density and direction of the field lines for the fundamental mode of either type of waveguide. (Draw just for one type of waveguide: metallic rectangular waveguide or slab waveguide or optical fiber) (25%)