國立中山大學104學年度碩士暨碩士專班招生考試試題

科目名稱：電磁學【光電所碩士班】　　題號：435002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）　　共1頁第1頁

1. In the general orthogonal coordinates, prove that the divergence of a vector function $\vec{B}$ is given by

$$\nabla\cdot\vec{B}=\frac{1}{h_1h_2h_3}\left(\frac{\partial B_1h_2h_3}{\partial u_1}+\frac{\partial B_2h_1h_3}{\partial u_2}+\frac{\partial B_3h_1h_2}{\partial u_3}\right)$$

Where B_i, h_i, and u_i (i = 1,2,3) are the coefficients, metric coefficients, and coordinates in the general orthogonal coordinate system, respectively. (10%)

2. A point charge +q is at a distance d from the center of a grounded conducting sphere of a radius a (a<d) as indicated in Figure 1. Please determine (a) the potential distribution and electric field intensity inside and outside the sphere (12%) and (b) the charge distribution induced on the surface of the sphere (6%). (c) If the conducting sphere is not grounded, please recalculate the potential distribution inside and outside the sphere. (10%)

3. An infinitely long coaxial transmission line has a solid inner conductor of radius a and a very thin outer conductor of inner radius c, in which two magnetic materials μ_1 and μ_2 are filled as shown in Figure 2. Determine the inductance per unit length of the line. (15%)

4. Please derive the equation of continuity from Maxwell's equations. (10%)

5. Please describe Maxwell's corrections to Ampere's Law. (10%)

6. Determine the dielectric constant and thickness of a transparent coating layer deposited on a glass substrate (ε_r = 4, μ_r = 1) to eliminate the reflection of red light (660 nm). (8%)

7. For a step-index fiber shown in Figure 3, assume the core index is n_1 = 1.45 and the cladding index is n_2 = 1.44. Also assume the free space wavelength of the light is λ_0 = 1.5 μm.
(a) Determine the numerical aperture NA and acceptance angle. (8%)
(b) What is the range of the propagation velocity along the fiber axis according to geometrical optics? (6%)
(c) What is the maximum value of the core radius R allowed for this fiber to operate at single mode condition for the wavelength range of 1.2~1.6 μm? (5%)
(Hints: The V-number of an optical fiber is defined as $V = 2\pi R(NA)\lambda_0^{-1}$. For single-mode operation, V < 2.405)

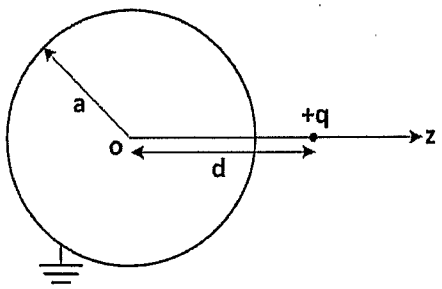

Figure 1

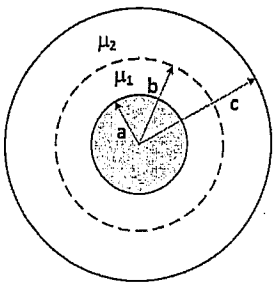

Figure 2

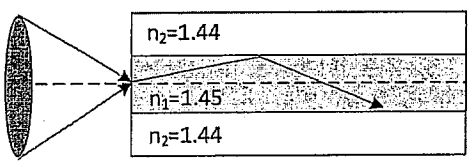

Figure 3