

國立中央大學八十七學年度碩士班研究生入學試題卷

所別: 大氣物理研究所 不分組 科目:

電磁學

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1.

A very long conducting cylinder of radius a carries charges Q per unit length along the symmetry axis of the cylinder. It is enclosed by another conducting cylinder of inner and outer radii b and c , respectively.

- (a) Calculate the electric field intensity at $r < a$, $a < r < b$, $b < r < c$, and $c < r$, where r is the distance from the symmetry axis. (5%)
- (b) What is the charge density on the inner surface of the outer conductor? (5%)
- (c) What is the charge density on the outer surface of the outer conductor? (5%)
- (d) What happens to the charge and the fields when the outer surface of the outer conductor is grounded? (5%)
- (e) What is the potential difference between the two conductors? (5%)

2.

A uniform charge distribution exists in a dielectric sphere radius a with permittivity ϵ , and surrounded by a concentric conducting shell (inner radius b , outer radius c). Determine: (a) the total stored energy, (b) the charge distribution, and (c) the electric potential, in the system. (15%)

3.

An air coaxial transmission line has a solid inner conductor of radius a and a very thin outer conductor of inner radius b .

- (a) Find the magnetic field at $r < a$, $a < r < b$, and $b < r$, where r is the distance from the center of the coaxial transmission line. (15%)
- (b) Show the results satisfying the boundary conditions of the magnetic field. (5%)
- (c) Determine the inductance per unit length of the line. (5%)

4.

The electric field \vec{E} of a uniform plane wave propagating in a dielectric medium is given by

$$\vec{E}(t, z) = \hat{x}[\cos(z/\sqrt{3} - 10^8 t)] - \hat{y}[2\sin(z/\sqrt{3} - 10^8 t)] \quad (V/m)$$

- (a) Determine the frequency and wavelength of the wave. (5%)
- (b) What is the dielectric constant of the medium? (5%)
- (c) Describe the polarization of the wave. (5%)
- (d) Find the corresponding magnetic field \vec{H} . (5%)
- (e) Calculate the energy density of the wave. (5%)
- (f) Determine the time average of Poynting vector over one period. (5%)
- (g) Find the velocity of the energy propagation. (5%)

