國立彰化師範大學 102 學年度碩士班招生考試試題

系所：機電工程學系　　組別：乙組(選考乙)　　科目：電磁學

☆☆請在答案紙上作答☆☆　　

1. A positive point charge Q is at the center of a spherical conducting shell of an inner radius R_a and an outer radius R_b. Please determine the electric field intensity and electric potential as functions of the radial distance R. (20%)

2. What are the boundary conditions for electrostatic fields at an interface between a conductor and a dielectric? (10%)

3. A parallel-plate capacitor consists of two parallel conducting plates of area A separated by a uniform distance d. The space between the plates is filled with a dielectric of a constant permittivity ε. Please determine the capacitance of the capacitor. (15%)

4. Determine the capacitance per unit length of a two-wire transmission line with parallel conducting cylinders of different radii r_1 and r_2, their axes being separated by a distance d (where $d > r_1 + r_2$) (15%)

5. Derive and find the magnetic flux density at the center of a square loop carrying a direct current I, with side w. (10%)

6. A very large slab of material of thickness d lies perpendicularly to a uniform magnetic field of intensity $\mathrm{H}_0 = \mathbf{a}_z H_0$. Ignoring edge effect, determine the magnetic field intensity in the slab:
   (a) if the slab material has a permeability μ, (10%)
   (b) if the slab is a permanent magnet having a magnetization vector $\mathbf{M}_i = \mathbf{a}_z M_i$. (10%)

7. Express the transformer emf induced in a stationary loop in terms of time-varying vector potential $\mathbf{A}$. (10%)