國立彰化師範大學 98 學年度碩士班招生考試試題

系所：光電科技研究所　　科目：電磁學

☆☆請在答案紙上作答☆☆　　共 1 頁，第 1 頁

1. (a)Find the electric field inside a uniformly charged sphere (radius *R*, charge density ρ). (b)Two spheres, each of radius *R* and carrying uniform charge densities +ρ and −ρ, respectively, are placed so that they overlap (Figure 1). Call the vector from the positive center to the negative center $\vec{\mathbf{d}}$. Find the electric field in the region of overlap. (15 %)

2. The potential at the surface of a sphere (radius *R*) is a constant V_0. Find the potential inside and outside the sphere. (20 %)

3. A sphere of linear dielectric material (radius *R*, dielectric constant ε_r) has embedded in a uniform free charge density ρ. Find the potential at the center of the sphere (relative to infinity). (15 %)

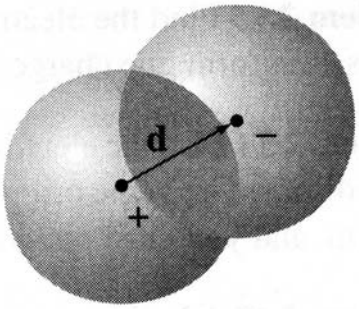
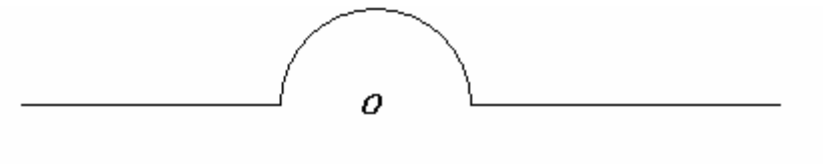


Figure 1

$$
\begin{aligned}
P_0(x) &= 1 \\
P_1(x) &= x \\
P_2(x) &= (3x^2 - 1)/2 \\
P_3(x) &= (5x^3 - 3x)/2 \\
P_4(x) &= (35x^4 - 30x^2 + 3)/8 \\
P_5(x) &= (63x^5 - 70x^3 + 15x)/8
\end{aligned}
$$

Legendre Polynomials

4. As shown in the following figure, an infinitely long wire carries a current ***I***. Now the wire is bent so that a semi-circular detour around the origin ***O*** with the radius ***R***. Calculate the magnetic field at the origin. (20%)



5. Write down the Maxwell's equations in a non-conducting medium with constant permeability and susceptibility. Assume further that it is source-free (no charge and no current). Show that both the electric and magnetic field satisfy the wave equation. Determine the speed of wave propagation. (15%)

6. Explain the following terms: dielectric, electric polarization, bound charge. (15%)