國立雲林科技大學
100學年度碩士班暨碩士在職專班招生考試試題

系所：電子光電所
科目：電磁學

1. Given a scalar field $V = 2xy - yz - xz$,
   (a) find the vector representing the direction and the magnitude of the maximum rate of increase of V at point $P(2, -1, 0)$, and (5%)
   (b) find the rate of increase of V at point P in the direction toward the point $Q(0, 2, 6)$. (5%)
   (c) If this scalar field V represents some electrical potential, determine the electric field intensity **E**. (5%)

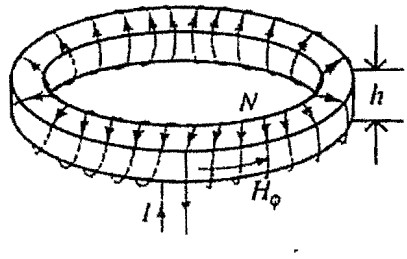
2. An inhomogeneous dielectric fills a parallel-plate capacitor of surface area A and thickness d. By measuring from the bottom plate, the dielectric constant is $\varepsilon_r = (1 + z)$.
   (a) Calculate the capacitance. (10%)
   (b) Calculate the electrostatic potential energy stored in this capacitor if a 9.0-V potential is applied across the conductors. (5%)

3. A block of iron (99.8% pure, $\mu_r = 5000$) exists for $z < 0$. For $z > 0$, we have air and a magnetic flux density $\mathbf{B}_{air} = 1\mathbf{a}_x + 4\mathbf{a}_y + 12\mathbf{a}_z$ T. Assuming there is no sheet current at the interface, find $\mathbf{B}_{iron}$. (15%)

4. Determine the electric field E at (8,0,0) m due to a charge of 10 nC distributed uniformly along the x axis between x = -5 m and x = 5 m. (15%)

5. An electron and photon separated by a distance of 10^{-11} m are symmetrically arranged along the z axis with z = 0. Find (a) the dipole moment, (b) the potential and (c) the electrical field at (3,4.12). (15%)

6. A toroidal winding with N turns, as shown in the figure, has inner radius a , the outer radius b and the height of the ring h . What is (a) the magnetic field intensity within the ring, (b) the energy story in the magnetic field of the toroidal winding (if the winding carries a current of I amperes)? (15%)



7. Write down the Maxwell's equations (differential form) and the physical meanings. (10%)