# 國立臺北科技大學 111 學年度碩士班招生考試

## 系所組別：2402 光電工程系碩士班

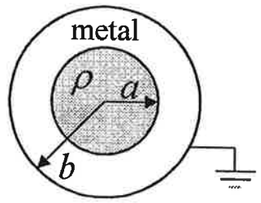
## 第二節　電磁學　試題（選考）



**注意事項：**

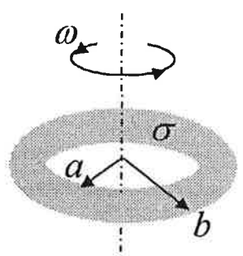
1. 本試題共 5 題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. The inside of grounded metal spherical shell (inner radius ***a*** and outer radius ***b***) is uniformly filled with space charge of charge density $\rho$.
   (a) Find the electrostatic energy of the system. (10%)
   (b) Determine the potential at the center. (10%)

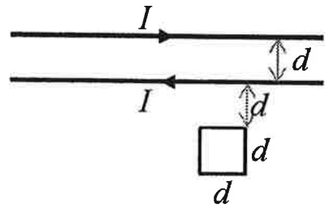



2. A parallel-plate capacitor of plate area ***0.1 m²*** and plate spacing ***5 mm*** is charged to ***100 V*** and is then disconnected from the battery. ($\varepsilon_0 = 8.9\times10^{-12}\ \frac{c^2}{Nm^2}$)
   (a) How much work is required if the plates are pulled apart to double the plate spacing? (10%)
   (b) What will be the final voltage on the capacitor? (10%)

3. A hollow disk of inner radius ***a*** and outer radius ***b***, carrying a uniform surface charge $\sigma$, is rotating at constant angular velocity $\omega$. Find its magnetic dipole moment. [15%]




4. Two infinite parallel wires separated by a distance ***d*** carry equal currents ***I*** in opposite directions, with ***I*** increasing at the rate $\frac{dI}{dt}$. A square loop of wire of length ***d*** on a side lies in the plane of wires at a distance ***d*** from one of the parallel wires, as shown in the figure.




   (a) Find the emf induced in the square loop. (10%)
   (b) Is the induced current clockwise or counterclockwise? Explain your answer. (10%)

5. A uniform sinusoidal plane wave with the following phasor expression for electric field

$$\vec{E}_i(\vec{r},t) = (-9\hat{x}+12\hat{z})e^{j(\frac{5}{2}\times10^{14}t-1\times10^{6}x-\frac{3}{4}\times10^{6}z)} \quad (V/m)$$

   is incident on a perfectly conducting plane at $z=0$.
   (a) Find the wavelength of the incident wave. (5%)
   (b) Determine the propagation velocity of the wave. (5%)
   (c) What is the dielectric constant of the medium for $x<0$? (5%)
   (d) Determine the angle of incidence. (5%)
   (e) Find the surface induced current density on the conducting wall. (5%)