112CC03

國立臺北科技大學 112 學年度碩士班招生考試

系所組別：2230 電子工程系碩士班丙組

第一節　電磁學　試題

注意事項：

1. 本試題共 4 題，每題 25 分，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。

Note: the following symbols can be used in your answers without converted to numerical values:

ε_0: permittivity of vacuum.

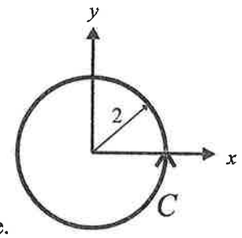
μ_0: permeability of vacuum.

η_0: intrinsic impedance of vacuum.

1. Two static point charges Q are located at (0,1,0) and (0,-1,0) in vacuum.
   (1) Find the electric field intensity $\vec{E}$ at (1,0,0). (15%)
   (2) Let S be the sphere of radius 2 with center located at (0, 0, 0). Find the closed surface integral of $\vec{E}$ on the sphere, i.e., $\oiint_S \vec{E}\cdot d\vec{s}$ (10%)

   Note: all coordinates are in rectangular coordinate. $Q = 1$ coulomb. All length units are in meter.

2. Two +z-directed infinite long DC straight line currents I are located at (0,1,0) and (0,-1,0) in vacuum.
   (1) Find the magnetic field intensity $\vec{H}$ at (1,0,0). (15%)
   (2) Let C be the path (right figure) following a circle of radius 2 on x-y plane with center located at (0, 0, 0). Find the closed line integral of $\vec{H}$ along the circle, i.e., $\oint_C \vec{H}\cdot d\vec{l}$ (10%)



   Note: all coordinates are in rectangular coordinate. $I = 1$ ampere. All length units are in meter.

3. A uniform plane wave propagating in vacuum in the direction of $\theta=90^\circ$ and $\varphi=45^\circ$ where θ and φ are the coordinate variables of spherical coordinate. The electric field can be expressed as follow:

   $$\vec{E}(x,y,z)=\hat{z}E_0 e^{-j(k_x x+k_y y+k_z z)}$$

   where $E_0=1\,\text{V/m}$ and $\hat{z}$ is the unit vector of z-axis. Let the frequency be 1 GHz.
   (1) Find k_x, k_y and k_z. (10%)
   (2) Find $\vec{H}(x,y,z)$. (15%)

4. An ideal lossless two-wire transmission line is located in an infinite medium with relative permittivity $\varepsilon_r=4$ and relative permeability $\mu_r=1$. Let the frequency be 1 GHz.
   (1) Find the phase velocity v_p of the transmission line. (5%)
   (2) Find the wavelength λ of the transmission line. (5%)
   (3) If the distributed inductance L of the transmission line is 1 nH/m, find the distributed capacitance C? (10%)
   (4) Continued from (3), find the characteristic impedance Z_0 of the transmission line . (5%)