# 國立臺北科技大學 103 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

## 第二節 電磁學 試題

注意事項：

1. 本試題共 6 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
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.  A uniform plane wave represented by

$$\mathbf{E}^i(x, t) = E_0 \cos(\omega t + \beta x)\hat{y} + E_0 \sin(\omega t + \beta x)\hat{z} \quad (\text{V/m})$$

impinges normally on a perfectly conducting plane at $x = 0$, find:
(a) the phasor expression of the incident wave, (5%)
(b) the polarization of the incident wave, (5%)
(c) the phasor expression of the reflected wave, (5%)
(d) the time-domain expression of the reflected wave, (5%)
(e) and the polarization of the reflected wave. (5%)

2.  An air-filled rectangular waveguide has dimensions $a = 6$ cm and $b = 4$ cm.
(a) Over what range of frequencies will the waveguide operate single mode? (5%)
(b) Over what range of frequencies will the waveguide support both $TE_{10}$ and $TE_{01}$ modes and no others? (5%)

3. The air-filled lossless transmission line shown in Figure 3.1 is operated with characteristic impedance $Z_0 = 100\ \Omega$, and the line is terminated with a load with complex impedance $Z_L$. The wave propagation is along the $\hat{z}$ direction, and the load is located at $z = 0$.

   (a) What is the value of the inductance per unit length $L$ (H/m) for this line? (5%)

   (b) The magnitude of the voltage is measured along the line and is shown in Figure 3.2. What is the value of the voltage standing wave ratio (VSWR)? (5%)

   (c) What fraction of the power incident upon the load is being reflected? (5%)

   (d) What is the input impedance at $z = -3$ m seen looking toward the load? (5%)
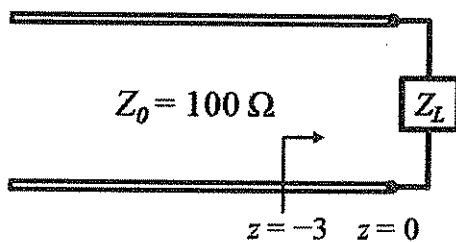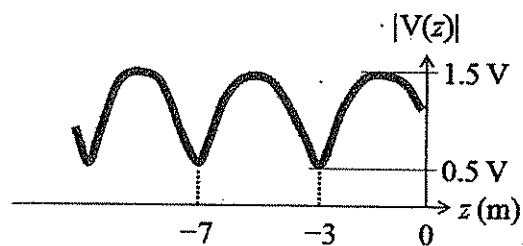


Figure 3.1                    Figure 3.2

4. Let the permeability $\mu = 3 \times 10^{-5}$ H/m, the permittivity $\varepsilon = 1.2 \times 10^{-10}$ F/m, and the conductivity $\sigma = 0$ everywhere in a certain medium. If the magnetic field in this medium is expressed by:

$$H = 2\cos(10^{10}t - \beta x)\hat{z} \quad \text{(A/m)}$$

   Use Maxwell's equations to find the expressions for:

   (a) the magnetic flux density $B$, (5%)

   (b) the electric flux density $D$, (5%)

   (c) the electric field $E$, (5%)

   (d) and the value of the propagation constant $\beta$. (5%)

   Please note that the above expressions should be along with their associated units.

注意：背面尚有試題

5. A series RL load shown in Figure 5 terminates a 50-Ω transmission line. The operational frequency is 500 MHz.
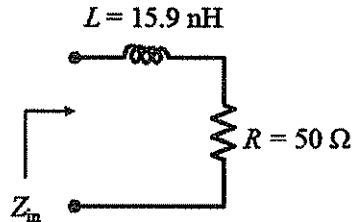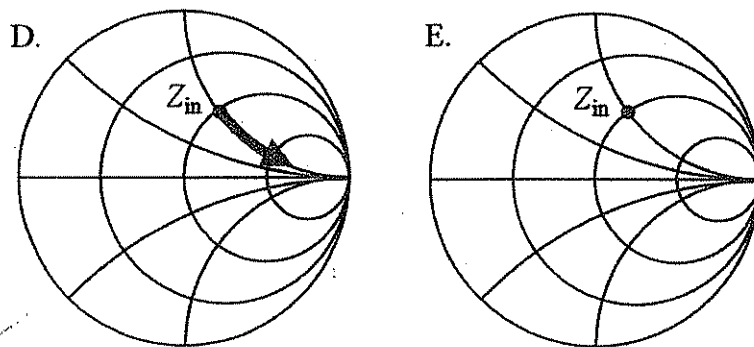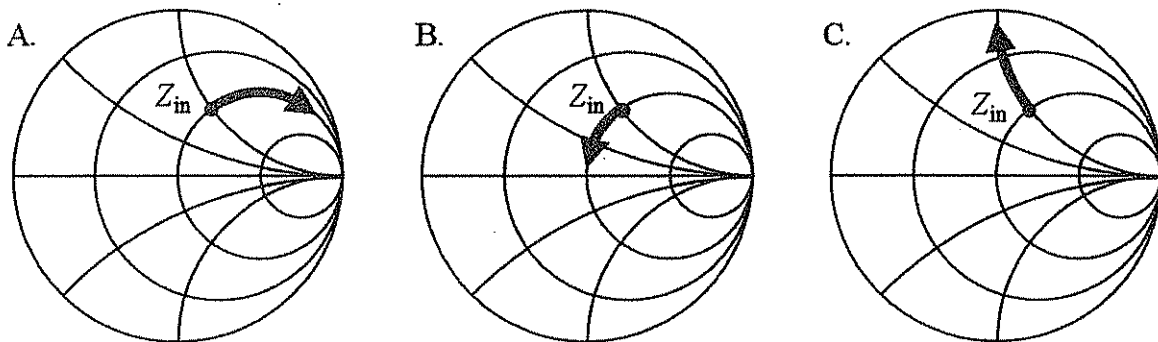
$$L = 15.9 \text{ nH}$$

$$R = 50 \ \Omega$$

$$Z_{in}$$

Figure 5

(a) What is the locus of $Z_{in}$ on the Smith chart if the operational frequency is varied from 500 MHz to 2 GHz? Select the correct one from A to E. (5%)

(b) What is the associated trace on the Smith chart if one connects a 150-Ω resistor with $Z_{in}$ in series? Select the correct one from A to E. (5%)

A. 

B. 

C. 

D. 

E. 

($Z_{in}$ remains the same)

6. The switch $S$ is closed at $t = 0$ for the system shown in Figure 6.

   (a) Plot the voltage at the load end for $0 < t < 6\,\mu s$. (5%)

   (b) Plot the voltage at the source end for $0 < t < 6\,\mu s$. (5%)

   (c) Find the voltage at the load and source ends for $t \to \infty$, respectively. (5%)

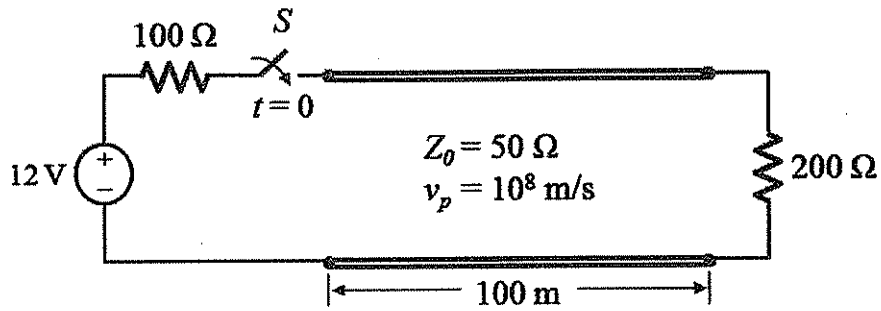100 Ω    $S$

$t = 0$

$Z_0 = 50\,\Omega$

$v_p = 10^8\,m/s$

12 V

200 Ω

100 m

Figure 6