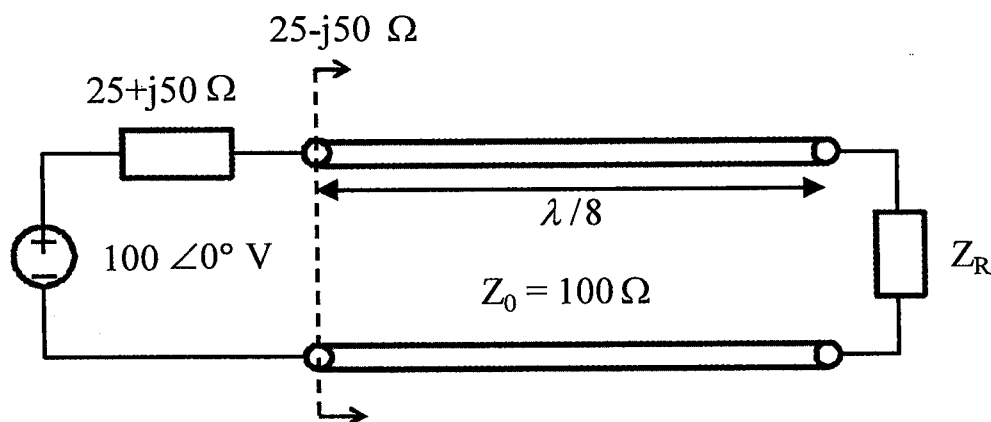


類組：電機類 科目：電磁學 B(3008)

※請在答案卷內作答

1. (20%) Please derive the Poynting's Theorem from the four Maxwell's Equations. And explain its physical meaning in plain language.
2. (10%) Write down the mathematical expression in phasor form for the E field of a plane wave if it is
  - a) Linearly-polarized traveling along  $-x$  direction.
  - b) Left-hand circularly-polarized traveling along  $+z$  direction.
3. (10%) For a hollow perfect metallic rectangular waveguide with a cross section  $a \times b$ , please make a drawing of its surface current on guide walls for  $TE_{10}$  mode. Here  $a = 2b$ .
4. (10%) Please explain in plain language why waveguide tends to exhibit the property of a high-pass filter.
5. (15%) Consider a lossless transmission line as shown in the following figure. If the input impedance of the line is  $(25-j50) \Omega$ , please answer the following questions.



- (5A) (8%) the value of the load impedance  $Z_R$
  - (5B) (7%) the power transferring to the load  $Z_R$
6. (15%) Consider electromagnetic waves:
    - (6A) (10%) Describe what basic attributes (the parameters) are required for a mathematical formula to model an electromagnetic wave.
    - (6B) (5%) Use rigorous mathematical expressions to explain why electromagnetic waves are transverse waves.

注意：背面有試題

參考用

類組：電機類 科目：電磁學 B(3008)

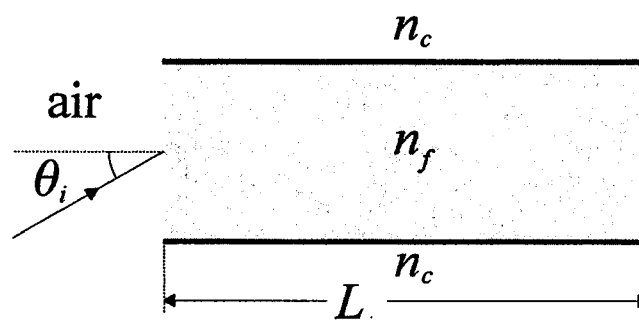
※請在答案卷內作答

7. (10%) The displacement  $x(t)$  of a vibrating electron under sinusoidal electric field  $E(t)$  of angular frequency  $\omega$  is given by

$$x(t) = \frac{q_e/m_e}{\omega_0^2 - \omega^2} E(t),$$

where  $q_e (>0)$ ,  $m_e$ ,  $\omega_0$  represent the charge, mass, and resonance angular frequency of an electron. If  $E(t) = E_0 \sin \omega t$ , plot  $E(t)$  and the displacement  $x(t)$  for a (i) free electron (with  $\omega_0 = 0$ ), and (ii) bound electron (with  $\omega \ll \omega_0$ ). Justify your answer.

8. (10%) Consider a ray in the air incident on a multi-mode optical fiber of length  $L$  with core and cladding indexes  $n_f$ ,  $n_c$  at an angle of  $\theta_i$ , as shown below



(8A) (5 %) What is the optical path length  $l$  experienced by the ray traversing the fiber? (*Hint: Path length depends on the tilt angle of the ray inside the fiber core.*)

(8B) (5 %) What is the maximum travel time difference between all guided rays? (*Hint: Rays can be guided if total internal reflection occurs.*)

注意：背面有試題

參考用