

※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

1. (選擇題) The reflection coefficient of a perpendicular polarization plane wave launched from medium 1 to medium 2 is (5 points for this question)

(a) $\Gamma_{\perp} = \frac{\eta_2 \cos \theta_2 - \eta_1 \cos \theta_1}{\eta_2 \cos \theta_2 + \eta_1 \cos \theta_1}$ (b) $\Gamma_{\perp} = \frac{2\eta_2 \cos \theta_2}{\eta_2 \cos \theta_1 + \eta_1 \cos \theta_2}$
(c) $\Gamma_{\perp} = \frac{\eta_2 \cos \theta_1 - \eta_1 \cos \theta_2}{\eta_1 \cos \theta_1 + \eta_2 \cos \theta_2}$ (d) $\Gamma_{\perp} = \frac{\eta_2 / \cos \theta_2 - \eta_1 / \cos \theta_1}{\eta_2 / \cos \theta_2 + \eta_1 / \cos \theta_1}$
(e) $\Gamma_{\perp} = \frac{2\eta_2 \cos \theta_2}{\eta_2 \cos \theta_2 + \eta_1 \cos \theta_1}$ (f) none of the above,

where η_1 and η_2 are the impedances in media 1 and 2, respectively, and θ_1 and θ_2 are the incident and refractive angles, respectively.

2. (選擇題) For a symmetric slab waveguide, core dielectric constant $\epsilon_1 = 2.56\epsilon_0$, cladding dielectric constant $\epsilon_2 = \epsilon_0$, waveguide thickness $d = 10\lambda_0$, where λ_0 is the wavelength in free space. The number of propagating TE modes is (8 points for this question)

(a) 10 (b) 15 (c) 20 (d) 25 (e) 30 (f) 35 (g) 40 (h) none of the above

3. (選擇題) The magnetic field of a uniform plane wave in free space is given by:

$$\vec{H} = H_0 \cos(6\pi \times 10^8 t + 2\pi y) \hat{x}$$

- (a) What is the direction of propagation of the wave? (3 points)
(b) What is the direction of the magnetic field at $t = 0, y = 0$? (3 points)
(c) What is the direction of the electric field at $t = 0, y = 0$? (3 points)
(d) What is the direction of the poynting vector? (3 points)
(e) What is the direction of the magnetic field at $t = 0, y = 0.5$? (3 points)

Please choose from the following answers:

(1) $+\hat{x}$, (2) $-\hat{x}$, (3) $+\hat{y}$, (4) $-\hat{y}$, (5) $+\hat{z}$, (6) $-\hat{z}$

4. (選擇題) The frequencies of oscillation for an air-dielectric rectangular cavity resonator of dimensions a , b , and d , in the x -, y -, and z -directions, respectively, are given for three modes as follows: (9 points for this question set)

$$f_{osc} = 3000\sqrt{5} \text{ MHz for TE}_{1,0,1} \text{ mode}$$

$$f_{osc} = 3000\sqrt{26} \text{ MHz for TE}_{0,1,1} \text{ mode}$$

$$f_{osc} = 3000\sqrt{30} \text{ MHz for TE}_{1,1,1} \text{ mode.}$$

Find a , b , and d from the following values.

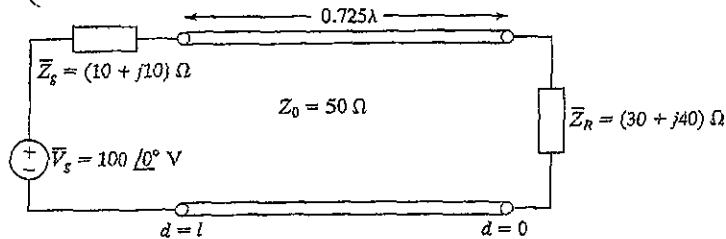
- 4.1 $a =$ (a) 1.0 cm (b) 1.5 cm (c) 2.0 cm (d) 2.5 cm (e) 3.0 cm (f) 4.0 cm (g) 5.0 cm (h) none of the above.
4.2 $b =$ (a) 1.0 cm (b) 1.5 cm (c) 2.0 cm (d) 2.5 cm (e) 3.0 cm (f) 4.0 cm (g) 5.0 cm (h) none of the above.
4.3 $d =$ (a) 1.0 cm (b) 1.5 cm (c) 2.0 cm (d) 2.5 cm (e) 3.0 cm (f) 4.0 cm (g) 5.0 cm (h) none of the above.

5. (選擇題) The power density pattern function of an antenna is $f(\theta, \phi) = \sin^2 2\theta$. The directivity is $D =$ (8 points for this question)

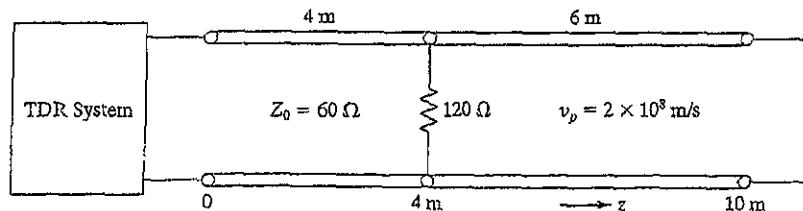
(a) 3/8 (b) 9/8 (c) 12/8 (d) 13/8 (e) 15/8 (f) 17/8 (g) none of the above.

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6. (選擇題) Let's consider the system shown below, and find out the time-average power delivered to the load from input impedance considerations. (3 points for each question, 15 points total)



- (a) What is the reflection coefficient at the load?
 (1) $0.5 \angle 0^\circ$ (2) $0.5 \angle 90^\circ$ (3) $1 \angle 0^\circ$ (4) $1 \angle 90^\circ$
- (b) What is the reflection coefficient at the input end $d=l$?
 (1) $0.5 \angle -72^\circ$ (2) $0.5 \angle 72^\circ$ (3) $1 \angle -72^\circ$ (4) $1 \angle 72^\circ$
- (c) What is the input impedance?
 (1) $(39.86 - j50.54) \Omega$ (2) $(39.86 + j50.54) \Omega$ (3) $(50.54 - j39.86) \Omega$ (4) $(50.54 + j39.86) \Omega$
- (d) What is the voltage across the input impedance?
 (1) $50.159 \angle 12.624^\circ \text{ V}$ (2) $50.159 \angle -12.624^\circ \text{ V}$
 (3) $100.159 \angle 12.624^\circ \text{ V}$ (4) $100.159 \angle -12.624^\circ \text{ V}$
- (e) What is time-average power delivered to the load?
 (1) 28.26W (2) 38.26W (3) 48.26W (4) 58.26W
7. (填充題，格子以外的計算過程不計分) An infinitely long, uniformly wound solenoid of radius a and having N turns per unit length carries a current I . Assuming air core ($\mu = \mu_0$), outside the solenoid the magnitude of the magnetic field intensity $|\vec{H}| =$ (a) (5 points), the magnitude of the magnetic flux density $|\vec{B}| =$ (b) (5 points), inside the solenoid the magnetic flux $\phi =$ (c) (5 points), and the inductance per unit length of the solenoid is (d) (5 points).
8. (填充題，格子以外的計算過程不計分) A transmission line under test is shown below. A discontinuity exists at $z = 4 \text{ m}$ and the line is short-circuited at the far end. A TDR (time-domain reflectometer) is connected at the input end $z = 0$, assuming the TDR pulses to be of amplitude 1V, duration 10 ns and the repetition rate 10^5 Hz . (5 points for each question, 20 points total)



- (a) The transmission coefficient at $z = 4 \text{ m}$ is _____.
- (b) Between 40 ns and 50 ns, the voltage at $z = 0 \text{ m}$ is _____.
- (c) Between 80 ns and 90 ns, the voltage at $z = 0 \text{ m}$ is _____.
- (d) Between 160 ns and 170 ns, the voltage at $z = 0 \text{ m}$ is _____.

試題隨卷繳回