國立中正大學
113學年度碩士班招生考試
試 題

[第 1 節]

科目名稱	電磁學
系所組別	電機工程學系-電磁晶片組

—作答注意事項—

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

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科目名稱：電磁學　　本科目共 3 頁　第 1 頁

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1. **(25%)** The impedance matching network shown in Fig. 1 is to match a lossless line having characteristic impedance Z_0=50 Ω with a load impedance Z_L. A quarter-wave line having characteristic impedance Z_i=80 Ω is connected to Z_L. Two stubs having characteristic impedance of 80-Ω each are connected to this quarter-wave line. One is a short-circuited (S.C.) stub of length 0.25 λ and the other is an open-circuited (O.C.) stub of length 0.5 λ. Assume that Z_L is pure resistance. Please answer the following questions:
   (a) (5%) Find Z_A
   (b) (5%) Find Z_B
   (c) (5%) Find Z_L when the impedance matching is achieved.
   (d) (5%) If we remove the matching network (quarter-wave line and two stubs) and directly connect Z_L to Z_0 , what is the standing wave ratio (SWR)?
   (e) (5%) Continue with (d), what percentage of the input power is transmitted to the Z_L ?

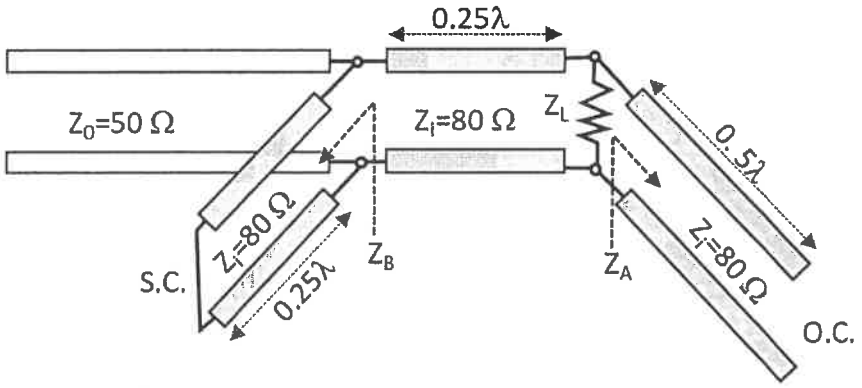
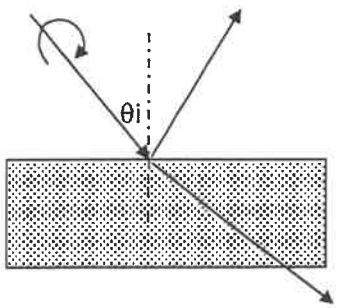


Fig. 1

2. **(16%)** A circular-polarized wave strikes a dielectric at incident angle θi as shown in Fig. 2. Please determine the polarizations of the transmitted wave and reflected wave when: 1) θi=critical angle (θ_C); 2) θi=Brewster angle (θ_B). Answer the questions in the order of (a), (b), (c), and (d) as indicated in the table below.



	Polarization	
	$\theta i=\theta_C$	$\theta i=\theta_B$
Transmitted Wave	(a)	(b)
Reflected Wave	(c)	(d)

Fig. 2

3. **(9%)** A wave traveling in a lossless, non-magnetic medium has an E-field amplitude of 26 V/m and an average power density of 4.5 W/m^2. Determine the propagation velocity of this wave.

4. **(10%)** A 5.0 cm diameter solid nickel wire, centered on the z-axis, conducts current with a density $\boldsymbol{J} = 5r$ A/cm^2 $\boldsymbol{a}_z$ (where r is in cm). Find:
   (a) (5%) The magnetic field intensity in the wire.
   (b) (5%) The internal inductance per unit length for the wire.

5. **(20%)** Two conducting planes of infinite extent in the z direction as shown in Fig. 3 are arranged at an angle of $\alpha = 30°$ and are bounded by cylindrical surfaces at $r_1 = 1$ cm and $r_2 = 2$ cm. One plate is held at a potential of $V_0 = 20\pi$ V and the other is grounded. Between the plates is a charge-free dielectric of dielectric constant $\varepsilon_r = 2$. Neglecting the fringing fields at the conductor edges, find:
   (a) (5%) The Laplace's equation between the plates in appropriate coordinate system.
   (b) (5%) The potential distribution between the plates.
   (c) (5%) The polarization vector between the plates.
   (d) (5%) The capacitance per unit length of the structure.

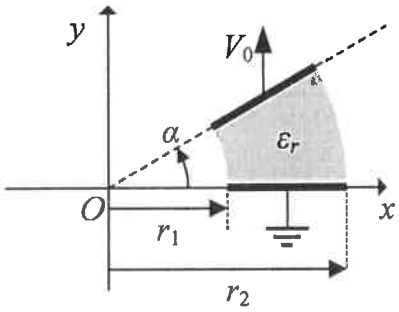


Fig. 3

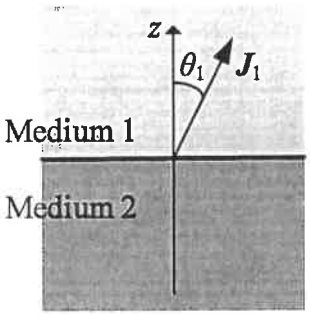


Fig. 4

6. **(12%)** The xy-plane ($z = 0$) serves as the interface between two different media as shown in Fig. 4. The current density J_1 in medium 1 ($\sigma_1 = 50$ S/m, $\varepsilon_{r1} = 8.0$) for $z > 0$ is 40 A/m^2. It makes an angle of $\theta_1 = 30°$ with respect to the normal at the interface. Medium 2 has a conductivity of $\sigma_2 = 5$ S/m and a dielectric constant of $\varepsilon_{r2} = 4$.
   (a) (4%) What is the current density J_2 in medium 2?
   (b) (4%) What is the angle does current density in medium 2 make with the normal?
   (c) (4%) What is the surface charge density at the interface?

7. **(8%)** A triangular wire loop has its vertices at the points (3, 0, 0), (0, 4, 0) and (0, 0, 5), with dimensions in meters. A time-varying magnetic field is given by $\boldsymbol{B} = 6t\,\boldsymbol{a}_y$ Wb/m^2 (t in seconds). If the wire has a total distributed resistance of 4 Ω, calculate the induced current and indicate its direction in a carefully drawn sketch.

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