

# 國立臺北科技大學

## 九十六學年度電腦與通訊研究所碩士在職專班入學考試

### 丙組：電磁學試題

填准考證號碼

第一頁 共一頁

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#### 注意事項：

1. 本試題共五題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

(請依序作答，作答與未作答之題號均請依序抄寫。)

一、Two dielectric media with permittivities  $\epsilon_1$  and  $\epsilon_2$  are separated by a charge-free arbitrarily curved boundary. The electric field intensity vector  $\vec{E}_1$  in medium 1 at point  $P$  along the curved dielectric boundary has a magnitude  $E_1$  and makes an angle  $\alpha_1$  with the normal pointing from medium 2 into medium 1 at point  $P$ . Please show that the magnitude  $E_2$  of the electric field intensity vector  $\vec{E}_2$  in medium 2 at point

$P$  satisfies the relationship  $E_2 = E_1 \sqrt{\sin^2 \alpha_1 + \left(\frac{\epsilon_1}{\epsilon_2} \cos \alpha_1\right)^2}$ . (20%)

二、Prove that the capacitance  $C$  and leakage resistance  $G$  between any two arbitrarily shaped conductors separated by a homogeneous lossy dielectric medium with permittivity  $\epsilon$  and conductivity  $\sigma$  satisfy the relationship  $C/G = \epsilon/\sigma$ . (20%)

三、Assuming that Lorentz condition  $\nabla \cdot \vec{A} + \mu\epsilon \frac{\partial V}{\partial t} = 0$  is chosen as the relation between vector magnetic potential  $\vec{A}$  and scalar electric potential  $V$ , please show that the nonhomogeneous wave equation for vector magnetic potential  $\vec{A}$  is  $\nabla^2 \vec{A} - \mu\epsilon \frac{\partial^2 \vec{A}}{\partial t^2} = -\mu \vec{J}$  where  $\mu$  and  $\epsilon$  are the respective permeability and permittivity of the homogeneous medium that contains the current density  $\vec{J}$ . (20%)

四、Suppose that the permittivity of nonmagnetic dielectric medium 1 is larger than that of nonmagnetic dielectric medium 2, i.e.,  $\epsilon_1 > \epsilon_2$ . When the electromagnetic wave in medium 1 is incident upon medium 2, please prove that the critical angle for total reflection to occur is given as  $\theta_c = \sin^{-1} \sqrt{\epsilon_2/\epsilon_1}$  where  $\theta_c$  is measured from the normal to the plane dielectric boundary pointing from medium 2 into medium 1. (20%)

五、A lossless quarter-wave line section of characteristic impedance  $Z_0$  is terminated with an inductive load impedance  $Z_L = R_L + jX_L$ . If the input impedance is denoted by  $Z_i = R_i + jX_i$  in parallel with  $jX_i$ , please determine both  $R_i$  (10%) and  $X_i$  (10%) in terms of  $Z_0$ ,  $R_L$ , and  $X_L$ .