國立臺灣科技大學 110 學年度碩士班招生試題

系所組別：電子工程系碩士班丙組

科　　目：電磁學

(總分為 100 分)

1. (20%)As in Figure 1

(1) Determine the mutual inductance between the conducting rectangular loop and a very long straight wire as shown below (10%)

(2)Determine the force acting on the loop with current I_1 on the loop and current I_2 on the very long straight wire? (10%)

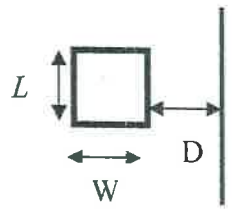

Figure 1

2.(20%) As in Figure 2

(1)Find the electric field at a point located at the center a semicircle wire with a uniform linear charge density ρ and with a radius **R** as shown below. (10 %)

(2)Find the electric potential of that point, assuming the potential at infinite distance is zero.(10%)

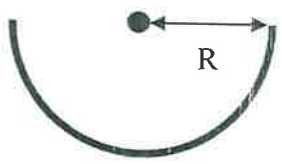

Figure 2

3. (10%)Please write down the divergence ($\nabla \cdot$) of a vector field A in spherical coordinate. (10%)

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4. (10%) For a uniform EM wave in medium 1 (with dielectric constant of ε_1) being incident on a medium 2 (with dielectric constant of ε_2).

(1). Please define the critical angle. (5%)

(2). When does the total reflection exist at an interface of two nonmagnetic media with $\mu_1 = \mu_2 = \mu_0$? (5%)

5. (10%) A uniform plane wave (UPW) is incident from free-space ($\mu_1 = \mu_0, \varepsilon_1 = \varepsilon_0$) onto a dielectric medium ($\mu_2 = \mu_0, \varepsilon_2$ $unknown$) at an oblique incident angle.

(1). Please find the value of ε_2 for which the Brewster's angle=60°. (5%)

(2). Please find the value of ε_2 for which the critical angle for the total internal reflection =60°. (5%)

6. (15%) Light can be treated as an electromagnetic wave. Consider a plane wave of infrared light which has a wavelength of $\lambda_0 = 1.0$ um when it propagates in the free space. Answer the following questions.

(1). What is the frequency f of this infrared light? (5%)

(2). What is the propagation constant (i.e. phase constant) β (rad/m) of this electromagnetic wave? (5%)

(3). If the magnitude of the wave's electric field intensity doubles, how should the power flow density change? (5%)

7. (15%) About the "skin depth", please answer the following questions.

(1). What is the physical meaning of the "skin depth"? (5%)

(2). What is the ratio of the "skin depth" in copper at f = 1 MHz to that at f = 100 MHz? (5%)

(3). For underwater communication, which frequency band would be better, higher band or lower one? Why? (5%)

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