國立臺南大學 104 學年度 **電機工程學系碩士班** 招生考試 電磁學 試題卷

1. A rectangular block has dimensions 1×1×10 cm. (a) What is the resistance of the block measured between the two square ends? (b) What is the resistance between two opposing rectangular faces? The conductivity of the block is 10^7 S/m. (10%)

2. (a) State Snell's law of refraction. (b) When does critical angle exist at an interface of two nonmagnetic media? (10%)

3. A straight, horizontal stretch of metal wire carries a current i = 25 A. What are the magnitude and direction of the magnetic field needed to "float" the wire, that is, to balance its weight? Its linear density is 50 g/m. (10%)

4. A parallel-plate capacitor of area S and separation d is charge to a voltage V. The permittivity of the dielectric is ε. Find the stored electrostatic energy. (10%)

5. Three charges (+2q, -4q, +2q) are arranged along the z-axis at $z = d/2$, $z = 0$, and $z = -d/2$, respectively. Determine V and **E** at a distant point $P(R,\theta,\phi)$. (10%)

6. Write Maxwell's equations in (a) point form and (b) integral form (c) explain the significance of each equation. (10%)

7. If the electric field intensity in space is given as $\vec{E} = E_0 cos\theta \hat{a}_r - E_0 sin\theta \hat{a}_\theta$, find (a) $\nabla \cdot \vec{E}$ (b) $\nabla \times \vec{E}$ (10%)

8. A uniform plane wave in free space is propagating in the $-a_y$ direction at a frequency of 10 MHz. If $\vec{E}$=400cosωt $\vec{a}_z$ V/m at y=0, write expressions for:
(a) $\vec{E}(x,y,z,t)$ (b) $\vec{H}(x,y,z,t)$ (10%)

9. Answer the following questions: (20%)
(a) What is the significance of the negative sign in the equation $\vec{E} = -\nabla V$?
(V : a scalar potential function)
(b) Given the scalar potential function V =10y(x^3+5) V, find $\vec{E}$ at the surface y=0