

國立台灣科技大學一百學年度碩士班招生試題

系所組別：電子工程系碩士班乙三組、丙組

科目：電磁學

(總分為100分)

1. In cylindrical coordinates, prove

(a) $\frac{\partial \hat{r}}{\partial \varphi} = \hat{\varphi}$ (5%)

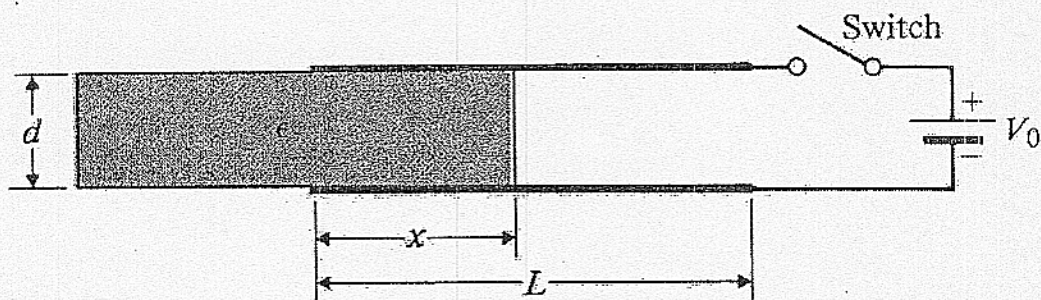
(b) $\frac{\partial \hat{\varphi}}{\partial \varphi} = -\hat{r}$ (5%)

(c) $\nabla \cdot \vec{A} = \frac{1}{r} \frac{\partial}{\partial r} (r A_r) + \frac{1}{r} \frac{\partial}{\partial \varphi} (A_\varphi) + \frac{\partial A_z}{\partial z}$ (10%)

[Hint: $\nabla = \hat{r} \frac{\partial}{\partial r} + \hat{\varphi} \frac{1}{r} \frac{\partial}{\partial \varphi} + \hat{z} \frac{\partial}{\partial z}$ and $\vec{A} = \hat{r} A_r + \hat{\varphi} A_\varphi + \hat{z} A_z$]

2. A parallel-plate capacitor of width
- w
- , length
- L
- , and separation
- d
- has a solid dielectric slab of permittivity
- ϵ
- in the space between the plates. The capacitor is charged to a voltage
- V_0
- by a battery, as indicated in the following figure. Assuming that the dielectric slab is withdrawn to the position shown, determine the force acting on the slab

- (a) with the switch closed. (10%)
-
- (b) after the switch is first opened. (10%)



3. The inner and outer radii of two concentric, thin, conducting, spherical shells are
- R_1
- and
- R_2
- respectively. The space between the shells is filled with an insulating material. The inner shell is maintained at a potential
- V_1
- and the outer shell at
- V_2
- . Determine the potential distribution in the insulating material by solving Laplace's equation. (10%)

[Hint: $\nabla^2 V = \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial V}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial V}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 V}{\partial \varphi^2}$]



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4. A perpendicularly polarized plane wave is obliquely incident on the rectangular wall as shown in Fig. 4. (a) Please calculate the reflection coefficient when the incident angle $\theta_i=0^\circ$. (10 %) (b) Please calculate the reflection coefficient when the incident angle $\theta_i=45^\circ$. (10 %)

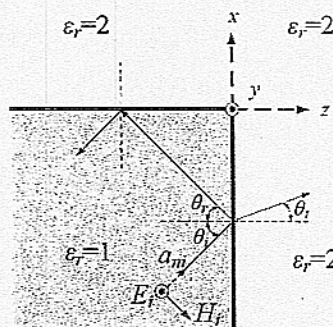


Fig. 4

5. Consider the transmission line circuit shown in Fig. 5. Assume that the switch is closed at $t=0$. Please calculate the load voltage v_L when $t=\infty$. (10 %)

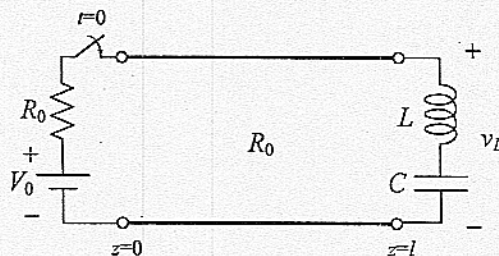


Fig. 5

6. Consider the transmission line circuit shown in Fig. 6. Assume that $Z_S=50/3 \Omega$ and $Z_L=30-j40 \Omega$. Please determine (a) the value of Z_0 (10 %) and (b) the line length l in terms of wavelength λ (10 %) that will match the impedance Z_L to the impedance Z_S .

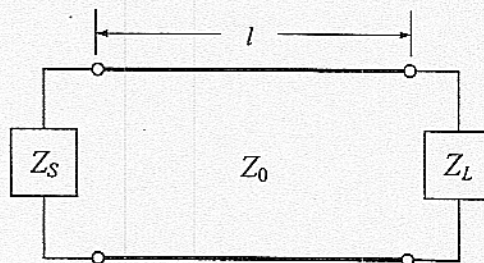


Fig. 6

