

## 國立臺灣科技大學 104 學年度碩士班招生試題

系所組別：光電工程研究所碩士班

科目：電磁學

(總分為 100 分)

Closed Book.

- (15%) The two plates of a parallel-plate capacitor are separated by a distance  $d$  and maintained at potentials 0 (at  $x=0$ ) and  $V_0$  (at  $x=d$ ) and are filled by constant charge density  $\rho_0$  between the plates. Determine (a) the electric potential between two plates (5%), (b) electric field between two plates (5%), (c) the surface charge densities on the plates (5%).
- (20%) Two extensive homogenous isotropic dielectrics meet on plane  $z=0$ . For  $z \geq 0$ ,  $\epsilon_{r1}=4$  and for  $z \leq 0$ ,  $\epsilon_{r2}=3$ . A uniform electric field  $\vec{E}_1 = 5\vec{a}_x - 2\vec{a}_y + 3\vec{a}_z$  kV/m existed for  $z \geq 0$ . Find in the  $z \leq 0$  (a) electric flux density  $\vec{D}_2$  in (10%), (b) electric flux density  $\vec{E}_2$  in (5%) (c) the polarization vector  $\vec{P}_2$  (5%).
- (15%) Consider an infinitely long transmission line consisting of two concentric conductive cylinders having their axes along the  $z$ -axis. The inner conductor has radius  $a$  and carries current  $I$  while the outer conductor has inner radius  $b$  and thickness  $t$  and carries current  $-I$ . Find the magnetic field everywhere.



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4. (20%) A uniform plane wave is propagating in the air. The electric field of this wave is given by

$$\vec{E} = 12\pi \cos(3\pi \times 10^8 t - \pi z) \hat{a}_x + 12\pi \sin(3\pi \times 10^8 t - \pi z) \hat{a}_y \text{ (V/m)}$$

Find (a) the phase velocity  $v_p$  (5%), (b) the wavelength  $\lambda$  (5%), and (c) the corresponding magnetic field  $\vec{H}$  (5%). (d) Determine the polarization of this propagating wave. [Hint: linear, elliptic, right-handed circular, or left-handed circular polarization.] (5%)

5. (15%) As shown in Fig. P5 (a), the impedance looking into the power amplifier is  $50 \Omega$ , but the impedance looking into the antenna is  $100 \Omega$ . In order to obtain the impedance match, a section of the lossless transmission line with a quarter-wave length ( $\lambda/4$ ) is inserted between two components. (a) Determine the characteristic impedance  $Z_0$  of the quarter-wave transmission line. (5%) As shown in Fig. P5 (b), if the designer makes a mistake to insert a  $\lambda/8$  transmission line with the impedance of  $Z_0$  between the antenna and amplifier, (b) find the impedance  $Z_m$  looking into the  $\lambda/8$  transmission line, (5%) and (c) calculate the corresponding reflection coefficient  $\Gamma$  at the output of the power amplifier (5%).

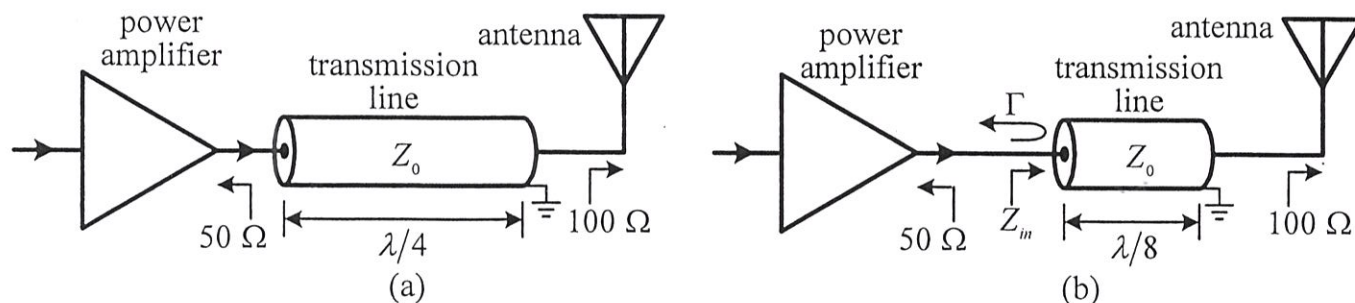


Fig. P5

6. (15%) An air-filled metallic rectangular waveguide with the transverse dimensions  $a=7.2$  cm and  $b=3.4$  cm operates at 3 GHz in the dominant mode. Find (a) cutoff frequency  $f_c$  (5%), (b) guided wavelength  $\lambda_g$  (5%), (c) wave impedance  $Z_{TE_{10}}$  (5%).

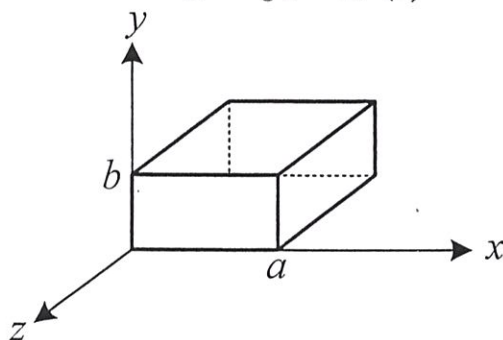


Fig. P6

