

EE3109

Answers of Assignment II

Ques.1

(a) Incident field

$$\vec{E}_i(z) = 100e^{-j1280z} \vec{x} \quad (\text{v/m})$$

$$\vec{E}_i(z, t) = 100 \cos(96 \times 10^9 t - 1280z) \vec{x} \quad (\text{v/m})$$

$$\vec{H}_i(z) = \frac{\vec{z} \times \vec{E}_i(z)}{\eta} = 1.061e^{-j1280z} \vec{y} \quad (\text{A/m})$$

$$\vec{H}_i(z, t) = 1.061 \cos(96 \times 10^9 t - 1280z) \vec{y} \quad (\text{A/m})$$

Reflected field

$$\vec{E}_r(z) = -100e^{j1280z} \vec{x} \quad (\text{v/m})$$

$$\vec{E}_r(z, t) = -100 \cos(96 \times 10^9 t + 1280z) \vec{x} \quad (\text{v/m})$$

$$\vec{H}_r(z) = 1.061e^{j1280z} \vec{y} \quad (\text{A/m})$$

$$\vec{H}_r(z, t) = 1.061 \cos(96 \times 10^9 t + 1280z) \vec{y} \quad (\text{A/m})$$

Total field

$$\vec{E}(Z) = \vec{E}_i(Z) + \vec{E}_r(Z) = -j200 \sin(1280z) \vec{x} (\text{v/m})$$

$$\vec{E}(Z, t) = 200 \sin(1280z) \sin(96 \times 10^9 t) \vec{x} (\text{v/m})$$

$$\vec{H}(Z) = \vec{H}_i(Z) + \vec{H}_r(Z) = 2.12 \cos(1280z) \vec{y} (\text{A/m})$$

$$\vec{H}(Z, t) = 2.02 \cos(1280z) \cos(96 \times 10^9 t) \vec{y} (\text{A/m})$$

(b)

$$z = -\frac{\lambda}{2} = -\frac{\pi}{\beta} = -2.45 \times 10^{-3} \quad (\text{m})$$

(c)

$$\vec{P} = \frac{1}{2} \text{Re}\{\vec{E} \times \vec{H}^*\} = 0$$

Ques.2

(a) (i) $V_i = \frac{Z_i}{Z_i + Z_g} V_g = 5.45 - j0.327 \quad (\text{v})$

$$I_i = \frac{1}{Z_i + Z_g} V_g = 0.091 + j0.00653 \text{ (A)}$$

$$V_L = \frac{Z_0}{Z_0 + Z_g} V_g e^{-j1.6\pi} (1 + \Gamma) = 1.373 + j4.22 \text{ (v)}$$

$$I_L = \frac{1}{Z_0 + Z_g} V_g e^{-j1.6\pi} (1 - \Gamma) = 0.034 + j0.105 \text{ (A)}$$

$$(ii) \quad \vec{P} = \frac{|V_L|^2}{2R_L} = 0.246 \text{ (w)}$$

(b) Using quarter wave transformer

$$Z_0 = \sqrt{Z_i \times Z_L} = 86.6 \text{ } (\Omega)$$

$$l = \lambda / 4$$

Ques.3

$$(i) \quad Y_s = -j0.65 / 600 = -j1.0833 \times 10^{-3}$$

$$Z_s = 1 / Y_s = j923.08 \text{ } (\Omega)$$

$$(ii) \quad SWR(S_1) = 1.9$$

$$(iii) \quad Z_L = 330 + j120$$

$$(iv) \quad \Gamma = |\Gamma| e^{j\theta_r} = 0.31 \angle 148^\circ$$

$$(v) \quad d = 0.5\lambda - 0.045\lambda = 0.455\lambda$$

$$(vi) \quad SWR(S_1) = 1.4$$

Ques.4

$$(a) \quad Z_0 = \sqrt{Z_i \times Z_L} = 86.6 \text{ } (\Omega)$$

(b) The stub positions and lengths:

$$d_1 = (0.5\lambda - 0.367\lambda) + 0.149\lambda = 0.282\lambda$$

$$l_1 = (0.5\lambda + 0.367\lambda) + 0.351\lambda = 0.484\lambda$$

or

$$d_2 = 0.411\lambda - 0.25\lambda = 0.161\lambda$$

$$l_2 = 0.09\lambda + 0.25\lambda = 0.34\lambda$$