HW 8

Problem 1

$$k_{cm} = \frac{m\pi}{d}$$
$$k_{min} = \frac{\pi}{d}$$
$$\lambda = \frac{2\pi}{k}$$
$$f = \frac{c}{\lambda} = 1875Hz$$

Problem 2

(a)

$$d = \sqrt{3}cm, \epsilon_1 = \epsilon_0$$
$$f = \frac{mc}{2d} \leq 30GHz$$
$$m_{max} = 3.46$$

(b)

$$H = y2H_0 cosk_x x e^{ik_z z}$$
$$E = \frac{2H_0}{w\epsilon}[xk_z cosk_x x - zik_x sink_x x]e^{ik_z z}$$
$$k_x = \frac{2\pi}{d}$$
$$H = y2H_0 cos\frac{2\pi}{d} x e^{ik_z z}$$
$$E = \frac{2H_0}{w\epsilon}[xk_z cos\frac{2\pi}{d} x - zi\frac{2\pi}{d} sink_x x]e^{ik_z z}$$

(c)

$$v_p = \frac{w}{k_z}$$
$$v_g = \frac{dw}{dk_z}$$
$$k_z^2 + (\frac{m\pi}{d})^2 = k^2 = w^2 u\epsilon$$
$$v_p v_g = \frac{1}{u\epsilon}$$
$$v_p = 3.67 * 10^8$$
$$v_g = \frac{c^2}{v_p} = 2.45 * 10^8$$

(d)

$$\epsilon_1 = 3\epsilon_0, d = \sqrt{3}cm$$

由于$\epsilon_1 > \epsilon_0$, 不会发生全反射

(e)

$$\epsilon_1 = 3\epsilon_0, d = \sqrt{3}cm$$

$$k_x = \frac{m\pi}{d}, k_z = \sqrt{k^2 - k_x^2}$$

由于折射率为$\sqrt{3}$, 布儒斯特角为$tan^{-1}\sqrt{3}$

$$k_x = 100K_0 sin60$$

$$\frac{m\pi}{d} = \frac{100m\pi}{\sqrt{3}} = 100 \cdot 2\pi \cdot \frac{\sqrt{3}}{2}$$

$$m = 3$$

Problem 3

$$\epsilon = 2.56\epsilon_0, d = 0.01, w = 30GHz$$

$$k_{cm} = \frac{m\pi}{d\sqrt{1 - \frac{u_1\epsilon_1}{u\epsilon}}}$$

$$k_{cm} < k, \frac{c \cdot k_{cm}}{2\pi} < 30 \cdot 10^9$$

$$m = 0, 1, 2$$

$$fundamental \quad modes是TE_0和TM_0, 频率范围为0 - 12GHz$$