

Problem 1 :

$$\text{given } f_0 = 1000 \text{ Hz}$$

$$f_0 = \frac{1}{2\pi\sqrt{6}RC}$$

$$\text{Let } C = 0.1 \mu\text{F} ; \therefore R = 649.7 \Omega$$

$$A_v \geq 29 \angle 180^\circ ; \therefore \frac{R_F}{R_i} = 29$$

$$\text{Let } R_i = 20\text{k} , \therefore R_F = 580\text{k}$$

Problem 2 :

$$\text{Since } C_1 = C_2 , \text{ and } R_4 = R_5$$

$$\therefore \omega_0 = \frac{1}{RC} = 37.33 \text{ K rad/s}$$

$$\text{To sustain the oscillation, } AB = 1$$

$$\therefore A = 3 = 1 + \frac{R_1}{R_2}$$

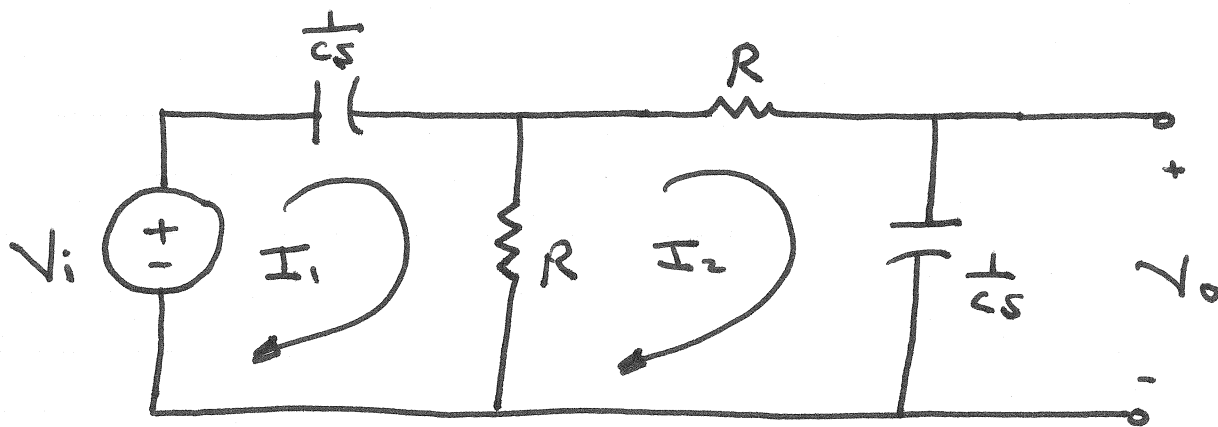
$$\therefore R_2 = 50\text{k}$$

At the beginning $AB > 1$, and the Zener diodes are open circuit

$$A = 1 + \frac{R_1 + R_3}{R_2} = 3.94 > 3 \quad (\text{building up})$$

Problem 3 :

To find $B(j\omega)$



$$V_i = (R + \frac{1}{c_s}) I_1 - R I_2$$

$$0 = -R I_1 + (2R + \frac{1}{c_s}) I_2$$

$$V_o = \frac{1}{c_s} I_2$$

$$I_2 = \frac{R}{R^2 + \frac{3R}{c_s} + \frac{1}{c_s^2 s^2}} V_i$$

$$\beta(s) = \frac{V_o}{V_i} = \frac{1}{3 + \frac{1}{Rc_s} + Rc_s}$$

$$\beta(j\omega) = \frac{1}{3 + j(\omega c R - \frac{1}{\omega c R})}$$

at ω_0 , $\beta(j\omega)$ must be real and positive

$$\therefore \omega_0 c R - \frac{1}{\omega_0 c R} = 0$$

$$\therefore \omega_0 = \frac{1}{RC}$$

$$\text{at } \omega_0; \beta = \frac{1}{3}$$

$$\therefore A_v \geq 3$$

$$1 + \frac{R_2}{R_1} \geq 3$$

$$\therefore \frac{R_2}{R_1} \geq 2$$

Problem 4 :

$$\text{At } \omega_0; Z_1 + Z_2 + Z_3 = 0$$

$$j\omega_0 L_1 + j\omega_0 L_2 - j \frac{1}{\omega_0 C} = 0$$

$$\therefore \omega_0 = \frac{1}{\sqrt{L_T C}}$$

$$L_T = L_1 + L_2 = 11.5 \text{ mH}$$

$$f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi \sqrt{L_T C}} = 68.457 \text{ kHz}$$

$$A_{v0} \leq -\frac{Z_1}{Z_2} = -\frac{L_1}{L_2} = -6.67$$

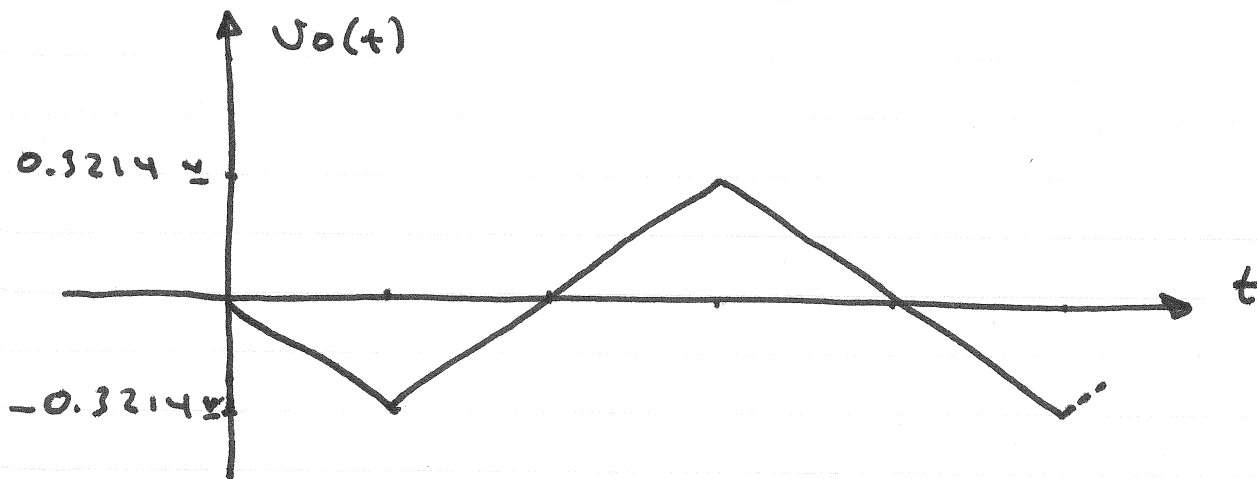
Problem 5:

$$f_o = \frac{1}{4R_1C} \frac{R_2}{R_3}$$

$$\therefore f_o = 1606.97 \text{ Hz}$$

$$V_U = \frac{R_3}{R_2} V_{\text{sat}} = 0.3214 \text{ V}$$

$$V_L = -\frac{R_3}{R_2} V_{\text{sat}} = -0.3214 \text{ V}$$



Problem 6:

$$f_o = \frac{1.44}{(R_1 + 2R_2)C_{ex}}$$

$$D = \frac{R_1 + R_2}{R_1 + 2R_2} \times 100 \%$$

$$\therefore C_{ex} = \frac{1.44}{f_o(R_1 + 2R_2)} = 0.0076 \text{ MF}$$

$$D = 56.58 \%$$