Problem 1 :

given $f_o = 1000\ Hz$

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

Let $C = 0.1\ MF$; $\therefore$ $R = 649.7\ \Omega$

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

Let $R_i = 20K$, $\therefore$ $R_f = 580K$

Problem 2 :

Since $C_1 = C_2$, and $R_4 = R_5$

$\therefore$ $\omega_o = \frac{1}{RC} = 33.33\ K\ r/s$

To sustain the oscillation , $AB = 1$

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

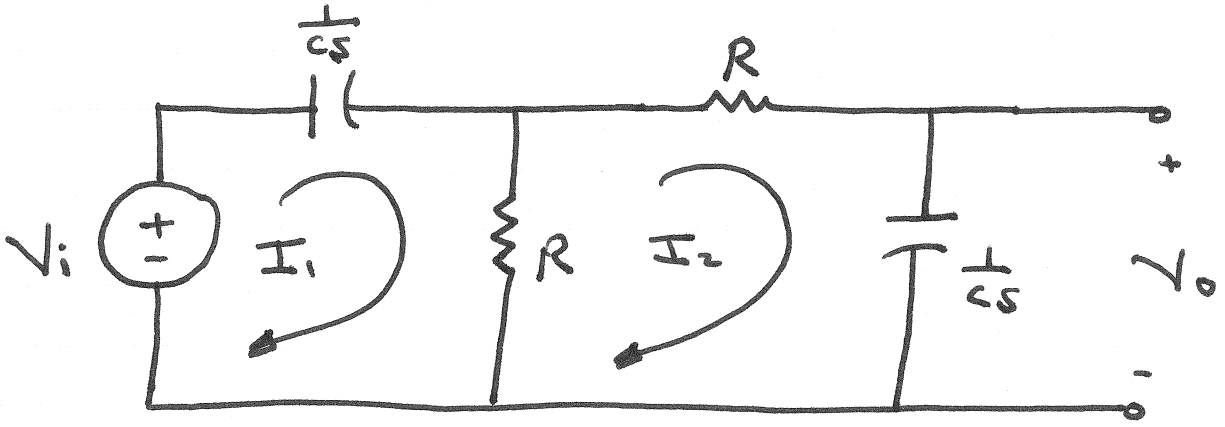
$\therefore$ $R_2 = 50K$

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

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

Problem 3 :

To find $\beta(j\omega)$



$$V_i = \left(R + \frac{1}{Cs}\right) I_1 - R I_2$$

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

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

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

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

$$\beta(j\omega) = \frac{1}{3 + j\left(\omega CR - \frac{1}{\omega CR}\right)}$$

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

$$\therefore \quad \omega_o CR - \frac{1}{\omega_o CR} = 0$$

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

at ω_o ; $\beta = \frac{1}{3}$

$$\therefore A_v \geq 3$$

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

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

Problem 4 :

At ω_o ; $Z_1 + Z_2 + Z_3 = 0$

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

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

$L_T = L_1 + L_2 = 11.5\,mH$

$$f_o = \frac{\omega_o}{2\pi} = \frac{1}{2\pi\sqrt{L_T C}} = 68.457\,KHz$$

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

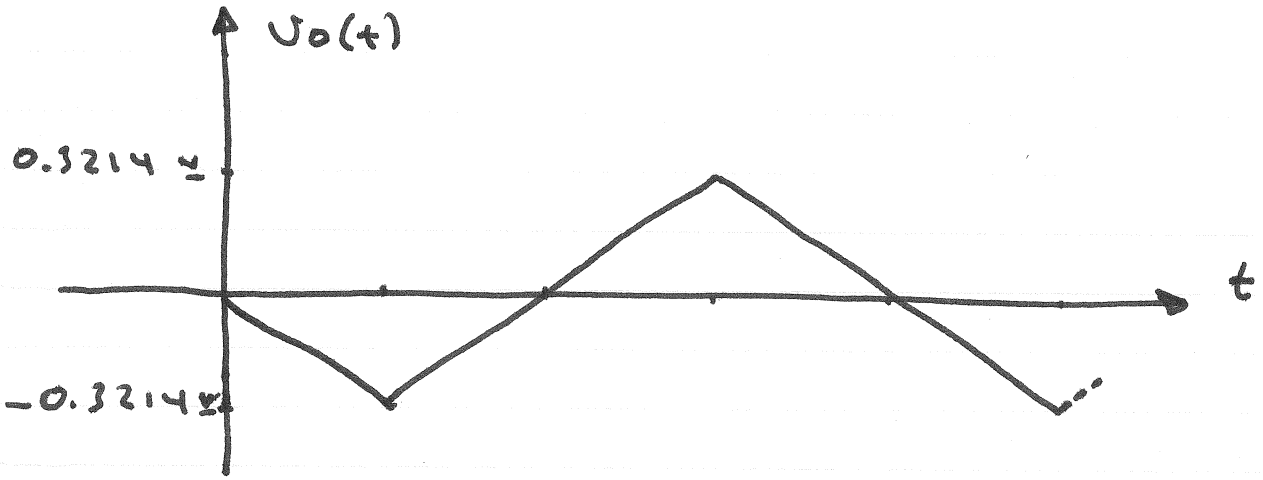
Problem 5:

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

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

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

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



Problem 6:

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

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

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

$$D = 56.58\ \%$$