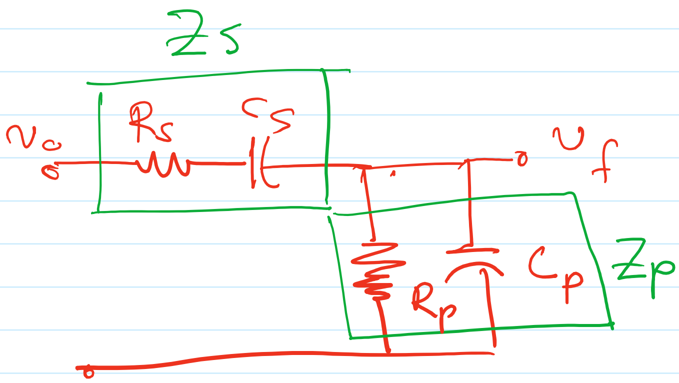
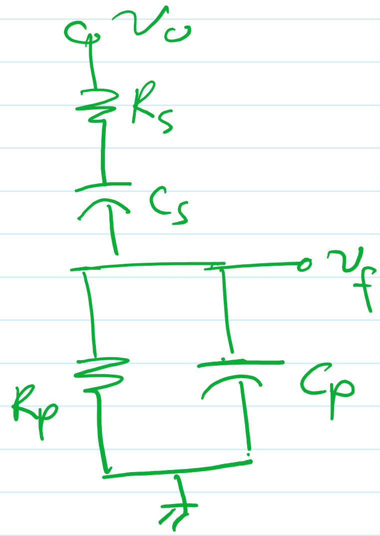
Oscilator

Wednesday, November 30, 2016 9:12 AM





$$\beta = \frac{v_f}{v_o}$$

$$\frac{v_f}{v_o} = T(s) = \frac{Z_p}{Z_p + Z_s}$$

$$Z_s = R_s + \frac{1}{sC_s} = \frac{1 + sR_sC_s}{sC_s}$$

$$Z_p = R_p \,||\, \left(\frac{1}{sC_p}\right) = \frac{R_p \times \frac{1}{sC_p}}{R_p + \frac{1}{sC_p}}$$

$$= \frac{R_p}{1 + sC_pR_p}$$

$$Z_p + Z_s = \frac{R_p}{1 + sC_pR_p} + \frac{1 + sR_sC_s}{sC_s}$$

$$= \frac{R_p sC_s + (1 + sC_pR_p)(1 + sR_sC_s)}{(1 + sC_pR_p)\, sC_s}$$

$$T(s) = \frac{Z_p}{Z_p + Z_s} = \frac{\dfrac{R_p}{1 + sR_pC_p}}{\dfrac{R_p s C_s + (1 + sC_pR_p)(1 + sR_sC_s)}{(1 + sC_pR_p)\, s C_s}}$$

$$= \frac{sC_sR_p}{sR_pC_s + (1 + sC_pR_p)(1 + sR_sC_s)}$$

$R_p = R_s = R$

$C_s = C_p = C$

$$T(s) = \beta(s) = \frac{CR}{sCR + (1 + sCR)^2}$$

$$= \frac{sCR}{sCR + 1 + 2sCR + s^2C^2R^2}$$

$$\beta(s) = \frac{sCR}{1 + 3sCR + s^2C^2R^2}$$

$s = j\omega$

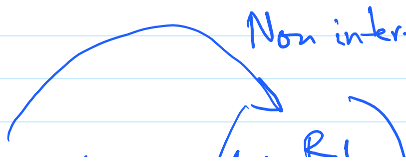
$$\beta(\omega) = \frac{j\omega CR}{1 + j3\omega CR - \omega^2C^2R^2}$$

$$= \frac{j\omega CR}{(1 - \omega^2C^2R^2) + j\omega 3CR}$$

Loop gain $A\beta$

for oscillation $|A\beta| = 1$

Non inverting Amplifier gain



$j\omega CR$

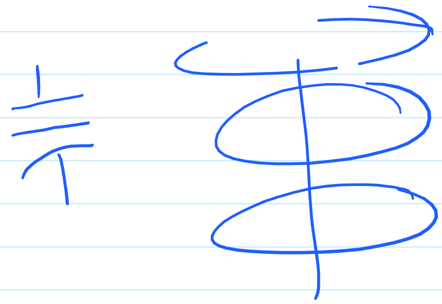
$$A\beta(\omega) = \left(1+\frac{R_1}{R_2}\right)\frac{j\omega CR}{(1-\omega^2C^2R^2)+j\omega 3CR}$$

Real part.

$$1-\omega_0^2C^2R^2 = 0$$

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

Frequency of oscillation is $f_0 = \frac{1}{2\pi RC}$



for oscillation

$$A\beta = \left(1+\frac{R_1}{R_2}\right)\frac{j\omega CR}{j3\omega CR} = 1$$

$$= \left(1+\frac{R_1}{R_2}\right)\frac{1}{3} = 1$$

$$\therefore \left(1+\frac{R_1}{R_2}\right) = 3$$

$$A = 3$$

$$\frac{R_1}{R_2} = 2$$