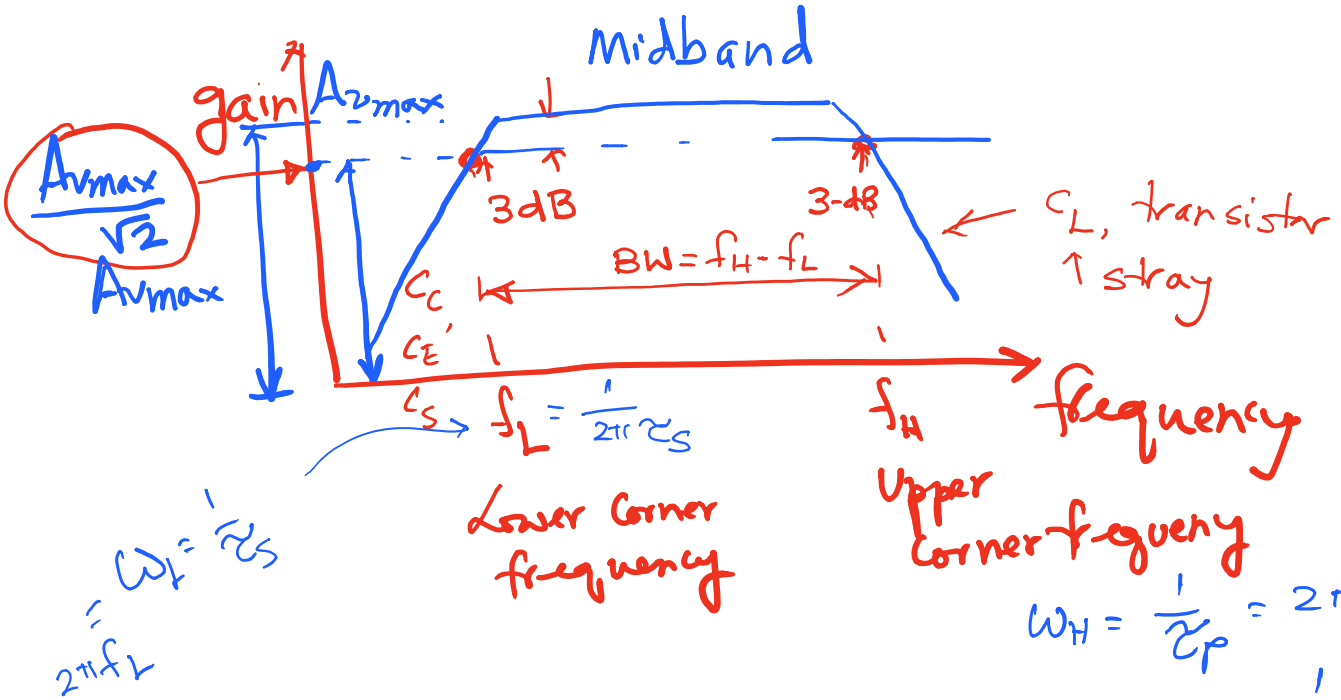
Frequency Response-2

Wednesday, September 14, 2016 8:35 AM

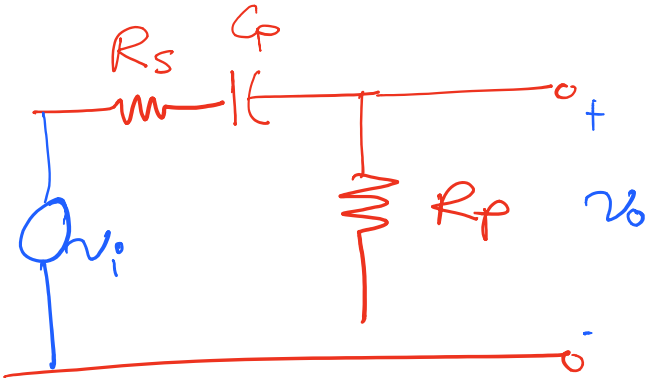
1. Draw the typical frequency response of an amplifier.



$\omega_L = \frac{1}{\tau_S} = 2\pi f_L$

$\omega_H = \frac{1}{\tau_p} = 2\pi f_H$

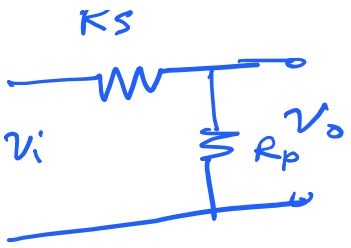
$f_H = \frac{1}{2\pi\tau_p}$



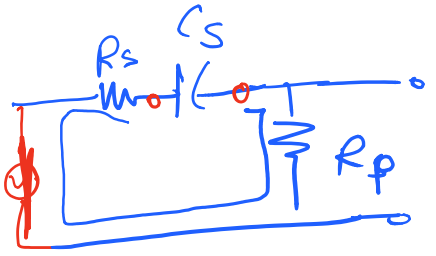
$T(s) = \frac{v_o(s)}{v_i(s)}$ Voltage transfer function

$= K \cdot \frac{s\tau_S}{1 + s\tau_S}$

$\frac{v_o}{} = \frac{R_p}{R_p + R_S}$

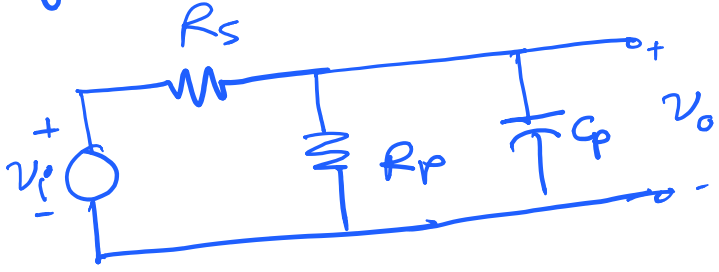


$$K = \frac{v_o}{v_i} = \frac{R_p}{R_p + R_s}$$



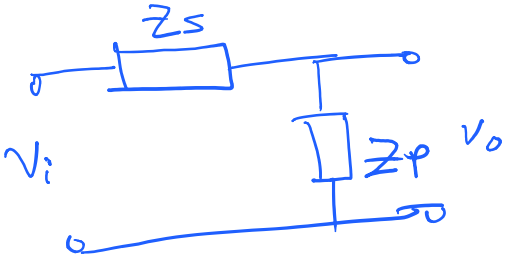
$$\tau_s = C_s (R_s + R_p)$$

Derive the transfer function of the following circuit



$$|Z_c| = \frac{1}{\omega C}$$

$$Z_c = \frac{1}{j\omega C} = \frac{1}{sC}$$



$$\frac{v_o}{v_i} = \frac{Z_p}{Z_p + Z_s}$$

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

Z_p ... $R_p + \frac{1}{sC_p}$

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

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

$$= \frac{R_p + R_s(1 + sC_pR_p)}{1 + sC_pR_p}$$

$$= \frac{(R_p + R_s) + sC_pR_sR_p}{1 + sC_pR_p}$$

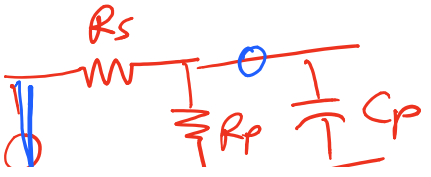
$$T(s) = \frac{Z_p}{Z_p + Z_s} = \frac{\frac{R_p}{1 + sC_pR_p}}{\frac{(R_p + R_s) + sC_pR_sR_p}{1 + sC_pR_p}}$$

$$= \frac{R_p}{(R_p + R_s) + sC_pR_sR_p}$$

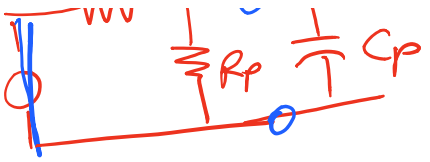
$$= \frac{R_p}{R_p + R_s} \cdot \frac{1}{1 + \frac{sC_pR_sR_p}{R_p + R_s}}$$

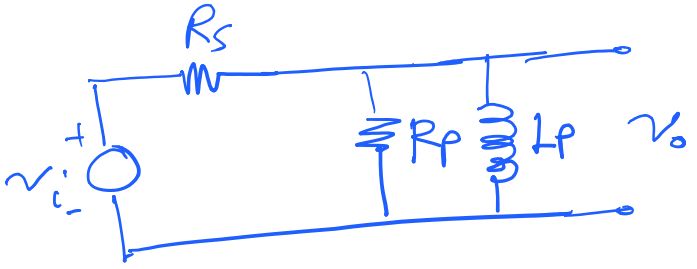
$$= K \cdot \frac{1}{1 + s\tau_p}$$

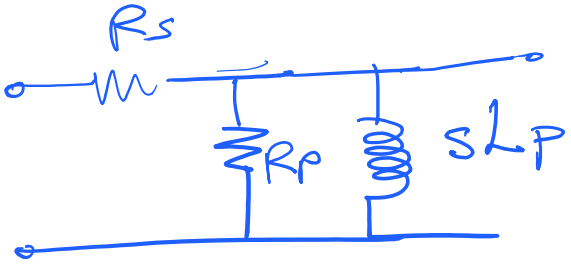
$\tau = C_p(R_p \| R_s)$



$\tau_p = C_p (R_p \| R_s)$







$\tau = \frac{L}{R_{eq}}$

$$Z_p = R_p \| (sL_p) = \frac{R_p sL_p}{R_p + sL_p}$$

$$Z_p + Z_s = \frac{R_p sL_p}{R_p + sL_p} + R_s$$

$$= \frac{R_p sL_p + R_s (R_p + sL_p)}{R_p + sL_p}$$

$$= \frac{sL_p [R_p + R_s] + R_s R_p}{R_p + sL_p}$$

$$\frac{R_p sL_p}{R_p + sL_p} = \frac{R_p sL_p}{}$$

$$\frac{Z_p}{Z_p+Z_s} = \frac{\frac{R_p SL_p}{R_p+SL_p}}{\frac{SL_p[R_p+R_s]+R_sR_p}{R_p+SL_p}} = \frac{R_p SL_p}{R_sR_p+SL_p(R_p+R_s)}$$

$$= \frac{R_p SL_p}{R_pR_s + SL_p(R_p+R_s)}$$

$$= \frac{R_p SL_p}{R_pR_s\left[1+\frac{SL_p(R_p+R_s)}{R_pR_s}\right]}$$

$$= \frac{R_p SL_p}{R_pR_s\left[1+S\tau_p\right]}$$

$$\tau_p = \frac{L_p\cdot(R_p+R_s)}{R_pR_s} = \frac{L_p}{\frac{R_pR_s}{R_p+R_s}}$$

$$= \frac{R_p SL_p(R_p+R_s)}{(R_p+R_s)\cdot R_pR_s\left[1+S\tau_p\right]}$$

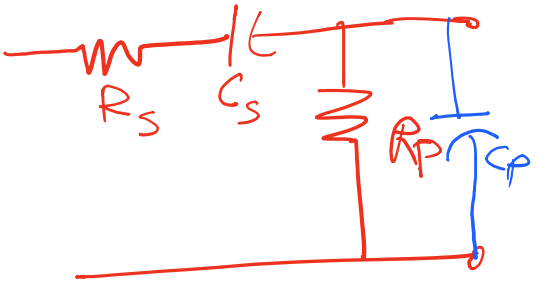
$$= \frac{L_p}{R_{eq}}$$

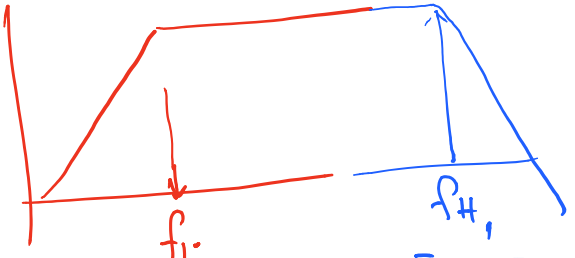
$$= K\cdot\frac{S\tau_p}{1+S\tau_p}$$

$$\tau = R_{eq}\,C$$

$$f_{Corner} = \frac{1}{2\pi\tau} = \frac{1}{R_{eq}}$$

$C_S \gg C_P$





$f_L = \frac{1}{2\pi\tau_S}$

$\tau_S = C_S(R_S + R_P)$

$f_H = \frac{1}{2\pi\tau_P}$

$\tau_P = C_P(R_P \| R_S)$