Part A (passive filters)

- First order Circuit :=)

* from theory :=)

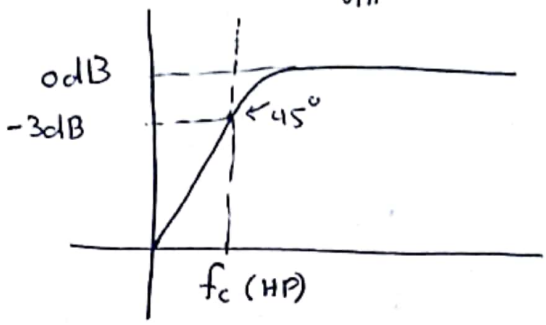
$$f_c = \frac{1}{2\pi RC} = \frac{1}{2(3.14)(2.2K)(220n)} = 328.999 \text{ Hz}.$$

* from figure 1.2 :=)

$f_c = 324.07$ Hz.

$\Rightarrow$ [High pass filter].

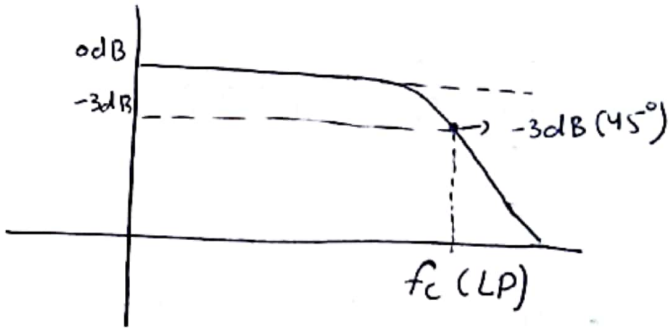
Gain = $20 \log \frac{V_{out}}{V_{in}}$



* from figure 1.3 :=)

$f_c = 330.483$ Hz

$\Rightarrow$ [low pass filter].



* phase shift from theory :=)

$$f(f_c) = \frac{1}{2\pi RC}$$

$$\Phi_c = -\tan^{-1}(2\pi RCf)$$

$$= -\tan^{-1}((2)(3.14)(2.2K)(220n)(328.999))$$

$$= -44.99997 \approx -45^\circ$$

- from figure 1.4 :=)

↳ Φ_r when $f \cong f_c \Rightarrow \Phi = 44.846^\circ$.

↳ Φ_c when $f \cong f_c \Rightarrow \Phi = -45.154^\circ$

Second Order Circuit :=))

- from theory :=))

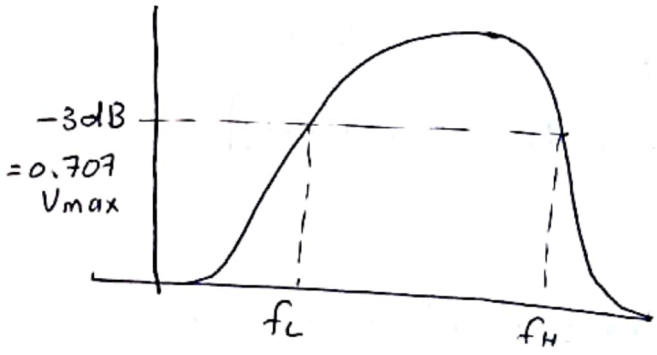
$$f_c = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2(3.14)\sqrt{(100mH)(470n)}} = 734.499\,Hz$$

$$\hookrightarrow 2\pi f_c = \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \pm \frac{R}{2L}$$

$$\Rightarrow \boxed{f = \frac{1}{2\pi}\left(\sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \mp \frac{R}{2L}\right)}$$

$$\hookrightarrow f_L = \frac{1}{2\pi}\left(\sqrt{\left(\frac{1K}{2(100m)}\right)^2 + \frac{1}{(100m)(470n)}} - \frac{1K}{2(100m)}\right] = 287.05\,Hz$$

$$\hookrightarrow f_H = 1879.4\,Hz.$$



- from figure 1.6 :=))

from Green graph :

$\hookrightarrow f_c = 726.752\,Hz$

$\hookrightarrow f_L = 288.121\,Hz$

$\hookrightarrow f_H = 1.909\,KHz.$

from Red graph :=))

$\hookrightarrow f_L = 288.121\,Hz$

$\hookrightarrow f_H = 1.909\,KHz$

$\Rightarrow$ Band Pass filter.

* phase shift from theory s=11.

$$\Phi_c = -\tan^{-1}\left[\frac{\frac{1}{LC} - (2\pi f_c)^2}{2\pi f_c R/L}\right]$$

Φ_c Ewhen $f = f_c = 734.499] \cong 0$ degree

Φ_c [when $f_c = 288.121] \cong -45$ degree

Φ_c [when $f_c = 1.909K] = 45$ degree.

from figure 10 7 s=11

* from Green graph s=11

Φ when $f = f_c = 533.691 \cong 0$ degree

Φ when $f = f_L =$ 44.865 degree

Φ when $f = f_{H} =$ -45.842 degree

* from Red graph s=11

Φ when $f = f_L =$ -45.522 degree

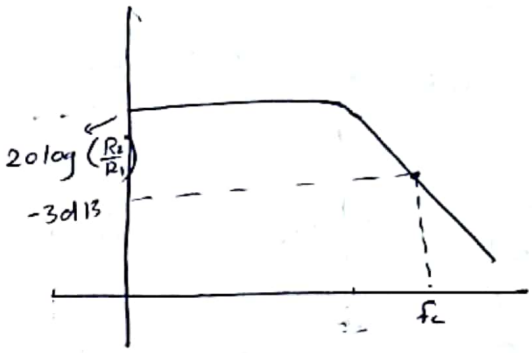
Φ when $f = f_H =$ 45.693 degree

Part B (Active filters) :=))

- from theory :=))

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2(3.141)(2.2k)(220n)} = 328.99\ Hz.$$

$$\Phi_c = -\tan^{-1}(2\pi f_c RC) \cong -45 \text{ degree.}$$



- from figure 10 :=))

- $f_c = 329.405\ Hz$ [low pass filter]

- $\Phi_{\text{when } f=f_c} = 135^\circ = -45^\circ$ in tan Φ.