Jakania (Experiment 5 & 6)

Cut off frequency $f = 1/2\pi RC$

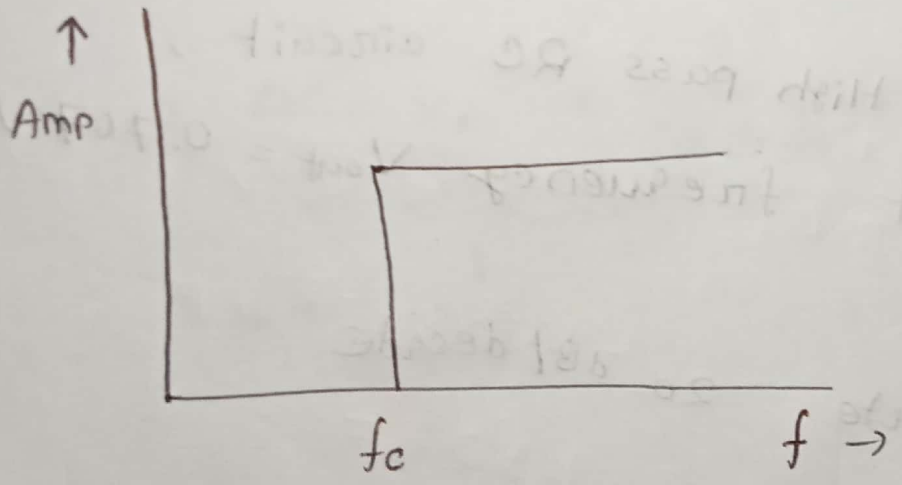
Low pass, phase difference

$$\theta = -\tan^{-1}(2\pi f RC)$$

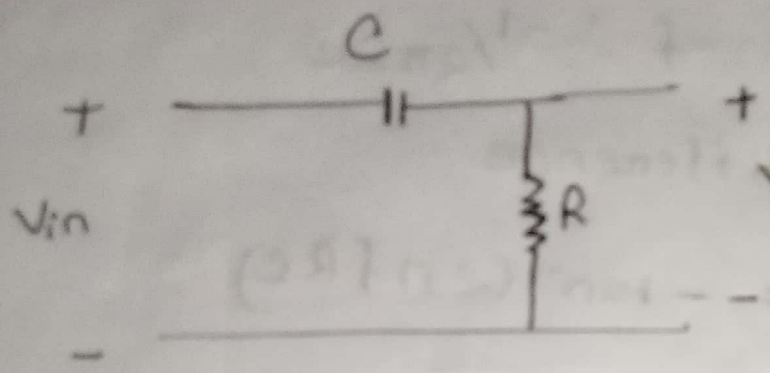
High pass. phase difference

$$\theta = \tan^{-1}(1/2\pi f RC)$$

1. Explain how high pass filter works.



pass all frequency up f_c



$$\omega = \frac{2\pi}{T}$$

$$V_{out} = \frac{R}{R + X_C} \times V_{in}$$

$$X_C = \frac{1}{\omega C}$$

$$= \frac{1}{2\pi f C}$$

$\omega = 0 \Rightarrow V_{out} = 0$

$\omega = \infty \Rightarrow V_{out} = V_{in}$

For Real High pass RC circuit, at cut off frequency $V_{out} = 0.707 V_i$

Increase Rate 20 dB/ decade

$$V_{out} = \frac{R}{R + X_C} \times V_{in}$$

$$\left| \frac{V_{out}}{V_{in}} \right| = \left| \frac{R}{R + X_C} \right|$$

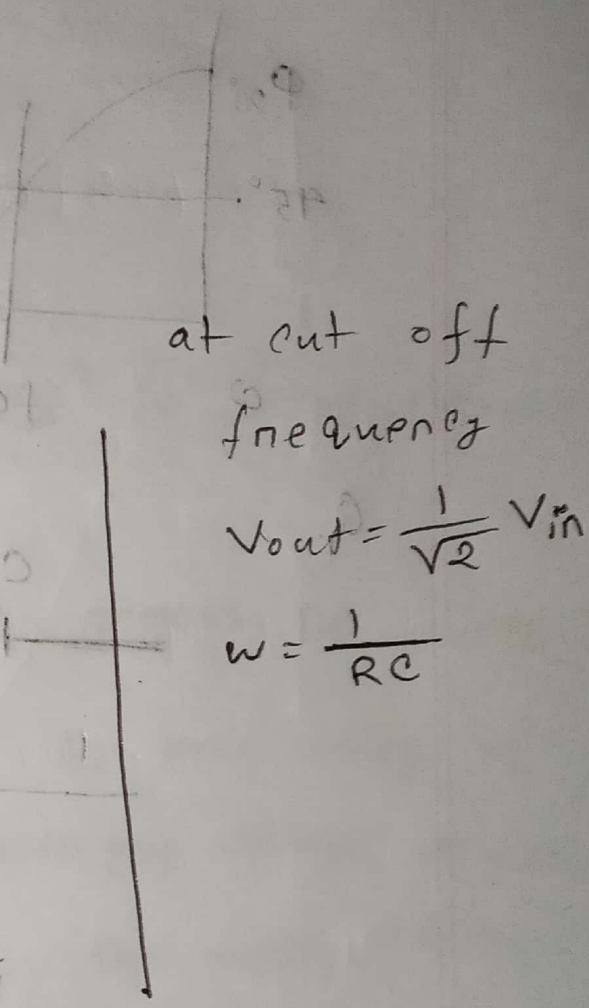
$$\left| \frac{V_{out}}{V_{in}} \right| = \frac{R}{\sqrt{R^2 + X_c^2}}$$

$$\frac{1}{2} = \frac{R^2}{R^2 + X_c^2}$$

$$\Rightarrow R^2 = X_c^2 = \frac{1}{(2\pi fc)^2}$$

$$f = \frac{1}{2\pi RC}$$

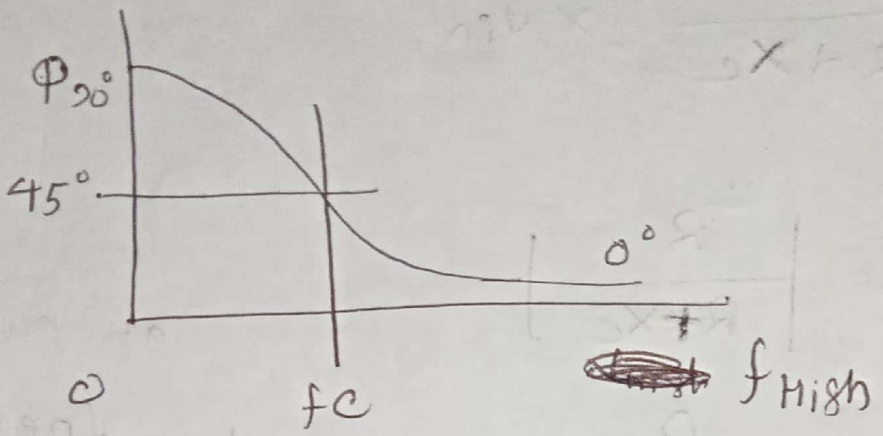
$$\theta = \tan^{-1}\left(\frac{1}{2\pi f R C}\right)$$



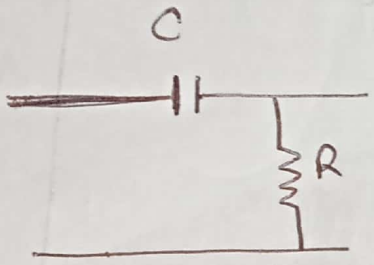
at cut off frequency

$$V_{out} = \frac{1}{\sqrt{2}} V_{in}$$

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



Q.



$f_c = 10\ kHz$

$R = 10\ k\Omega$

$C = ?$

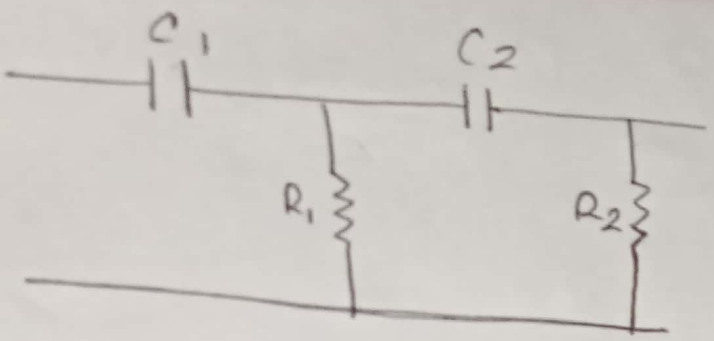
$$C = \frac{1}{2\pi R f} = \frac{1}{2\pi \times 10 \times 10^3 \times 10 \times 10^3}$$

$$= 1.59 \times 10^{-3}\ \mu F$$

$$= 1.59\ nF$$

Higher order will give good result

$$f_c = \frac{1}{2\pi \sqrt{R_1 C_1 R_2 C_2}}$$



2. What happens if DC voltage is passed through capacitor?

⇒ When capacitors are connected across DC supply voltage they become charged to the voltage of applied voltage, acting like temporary storage device and hold this charge as long as the supply voltage is present.