

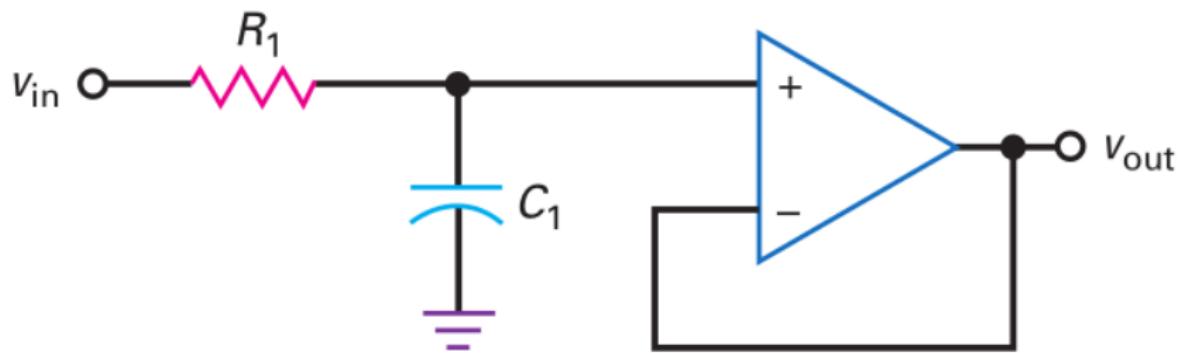


Electronic Circuit II

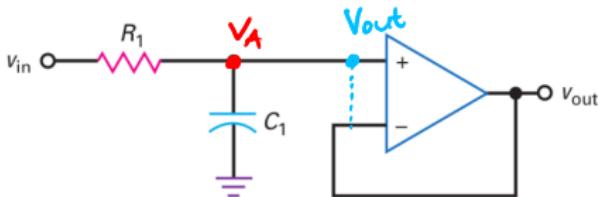
Active Filter First Order

Mifta Nur Farid

Low Pass Filter Circuit



$$\textcircled{1} \quad V_{out} = V_A$$



$$V_A = \frac{-jX_C}{R-jX_C} \cdot V_{in}$$

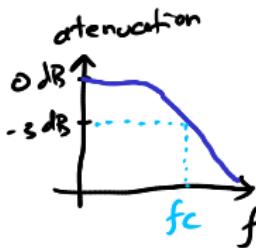
$$\frac{V_A}{V_{in}} = \frac{-jX_C}{R-jX_C}$$



$$X_C = \frac{1}{2\pi f C} \Rightarrow \frac{V_A}{V_{in}} = \frac{-jX_C}{R-jX_C} = \frac{-j\left(\frac{1}{2\pi f C}\right)}{R-j\left(\frac{1}{2\pi f C}\right)} \times \frac{\frac{2\pi f C}{2\pi f C}}{\frac{2\pi f C}{2\pi f C}}$$

$$= \frac{-j}{2\pi f RC - j} \times \frac{j}{j} = \frac{1}{j^2 2\pi f RC + 1}$$

$$\boxed{\frac{V_A}{V_{in}} = \frac{1}{j^2 2\pi f RC + 1}}$$



$$\frac{V_A}{V_{in}} = -3 \text{ dB} = \frac{1}{j2\pi f RC + 1}$$

$$-3 \text{ dB} = 20 \log \frac{V_A}{V_{in}}$$

$$\frac{-3}{20} = \log \frac{V_A}{V_{in}}$$

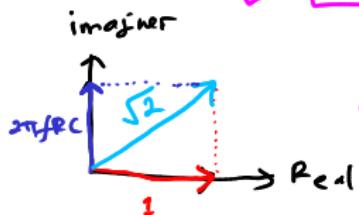
$$-0.15 = \log \frac{V_A}{V_{in}}$$

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

$$\frac{1}{\sqrt{2}} = \frac{1}{j2\pi f RC + 1}$$

$$\sqrt{2} = j2\pi f RC + 1$$

$$\sqrt{2} = 1 + j2\pi f RC$$



Sehingga magnitude dan bilangan kompleks:

$$(\sqrt{2})^2 = 1^2 + (2\pi f RC)^2$$

$$2 = 1 + (2\pi f RC)^2$$

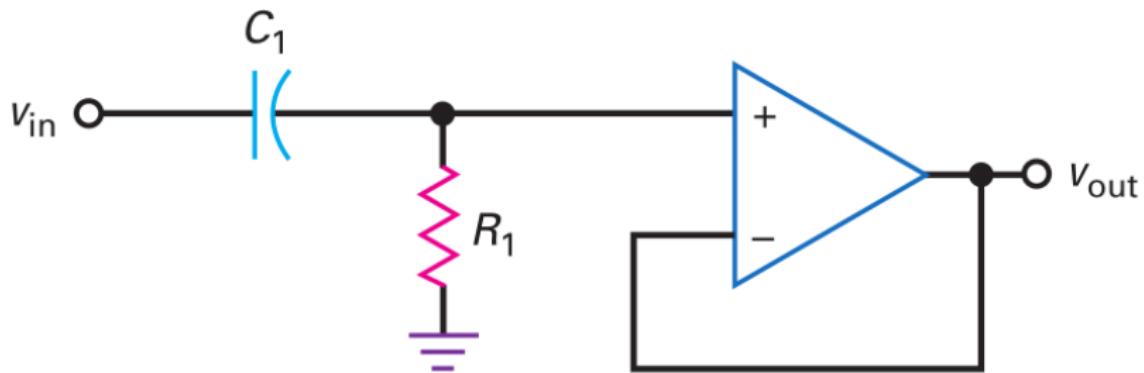
$$1 = 2\pi f RC$$

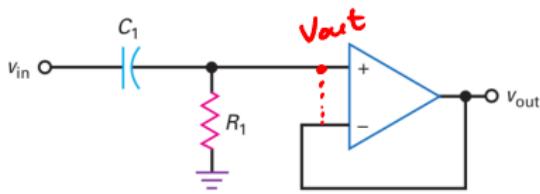
$$1 = 2\pi f RC$$

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

freq. cut off filter! (f_c)

High Pass Filter Circuit





$$V_{out} = \frac{R}{R - jX_C} \cdot V_{in}$$

$$\frac{V_{out}}{V_{in}} = \frac{R}{R - jX_C}$$

$$-3\text{dB} = \frac{1}{\sqrt{2}} = \frac{R}{R - jX_C} = \frac{1}{1 - j\frac{X_C}{R}}$$

magnitude $\Rightarrow \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{1^2 + \frac{X_C^2}{R^2}}} = \frac{1}{\sqrt{1 + \frac{X_C^2}{R^2}}}$

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

$$1 = \frac{X_C}{R}$$

$$X_C = R$$

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

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

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

freq.
cut-off.