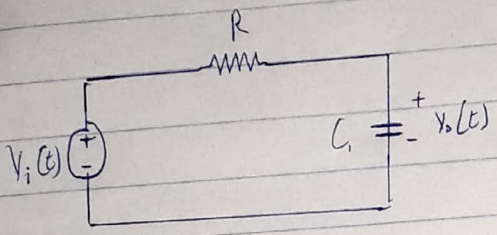
ASITA OBOMISO

17/ENG06/014

~~MECHANIC~~ MECHATRONICS ENGINEERING

EEE 322



Determine the type of filter shown below and show that its Cut-off Frequency is

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

Converting to frequency domain

$$R = R$$

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

$$H(\omega) = \frac{V_o}{V_i}$$

Using kirchoff voltage law

$$H(\omega) = \frac{V_o}{V_i} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{\frac{1}{j\omega C}}{\frac{Rj\omega C + 1}{j\omega C}}$$

$$\therefore H(\omega) = \frac{1}{1 + j\omega RC}$$

When $H(\omega) = 1$, $H(\infty) = 0$

The half power frequency, which is equivalent to the corner frequency on the Bodeplots but in the context of filters is usually known as Cut off Frequency ω_c is obtained by setting magnitude of $H(\omega)$ equal to $\frac{1}{\sqrt{2}}$

Substituting ω_c

$$H(\omega_c) = \frac{1}{\sqrt{1 + \omega_c^2 R^2 C^2}} = \frac{1}{\sqrt{2}}$$

Making ω_c subject of the formula

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

Cross multiplying

$$2 - 1^2 = 1 + \omega_c^2 R^2 C^2$$

$$2 = 1 + \omega_c^2 R^2 C^2$$

$$1 = \omega_c^2 R^2 C^2$$

Squaring both sides

$$\sqrt{2} = \sqrt{\omega_c^2 R^2 C^2}$$

$$1 = \omega_c R C$$

dividing both sides by $\omega_c RC$

$$\omega_c = \frac{1}{RC_{11}}$$