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Tugas Isyarat dan Sistem

5.75. Diketahui :

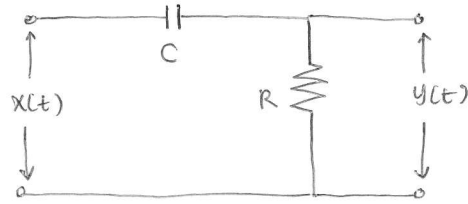


Figure 5-39

Ditanyakan: Temukan tanggapan frekuensi $H(\omega)$ dari filter ini, dan tipe filter apakah rangkaian ini.

Jawab :

a. $i_C = i_R$

$$C \frac{dV_C}{dt} = \frac{V_o}{R}$$

$$C \left(\frac{dx(t)}{dt} - \frac{dy(t)}{dt} \right) = \frac{1}{R} y(t)$$

$$y(t) = RC \left(\frac{dx(t)}{dt} - \frac{dy(t)}{dt} \right)$$

$$\frac{1}{RC} y(t) = \frac{dx(t)}{dt} - \frac{dy(t)}{dt}$$

↓ Fourier

$$\frac{1}{RC} Y(j\omega) = j\omega X(j\omega) - j\omega Y(j\omega)$$

$$\left(\frac{1}{RC} + j\omega \right) Y(j\omega) = j\omega X(j\omega)$$

$$H(j\omega) = \frac{Y(j\omega)}{X(j\omega)}$$

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

b. Rangkaian filter RC ini adalah rangkaian highpass filter.

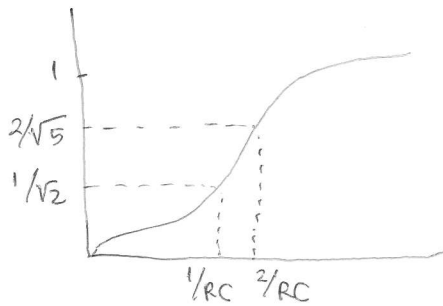
c. Gambar tanggapan frekuensi.

$$|H(j\omega)| = \frac{\sqrt{C^2 \omega^2}}{\sqrt{\omega^2 + \left(\frac{1}{RC}\right)^2}} = \frac{\omega}{\sqrt{\omega^2 + \left(\frac{1}{RC}\right)^2}}$$

$$\omega = 0 \rightarrow |H(j\omega)| = 0$$

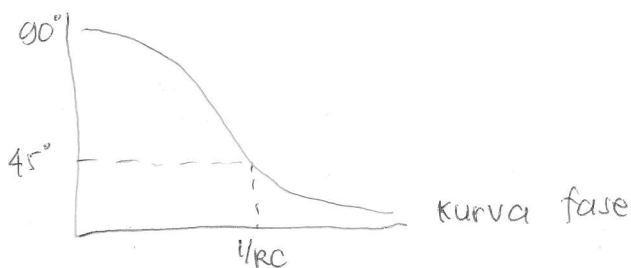
$$\omega = 1/RC \rightarrow |H(j\omega)| = \frac{1/RC}{1/RC\sqrt{2}} = 1/2$$

Kurva magnitude



$$\omega = \frac{2}{RC} \rightarrow |H(j\omega)| = \frac{2/RC}{1/RC\sqrt{5}} = \frac{2}{\sqrt{5}}$$

$$\begin{aligned} \phi = \text{fase} = \angle H(j\omega) &= \arctan \frac{\omega}{0} - \arctan \frac{\omega}{1/RC} \\ &= 90^\circ - \arctan \omega RC \end{aligned}$$



d. Batas Bandwidth $\rightarrow$ saat magnitude mencapai $\frac{1}{\sqrt{2}}$ / half power (3 dB) frekuensi. Jadi Bw memiliki batas kiri $1/RC$.
Bandwidth $> 1/RC$.