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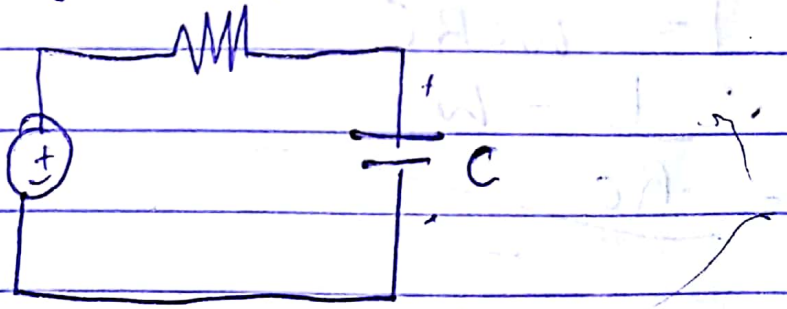
17/Eng04/041
Electrical/Electronics Engineering
Circuit Theory II EEE 322

1) Determine the type of filter shown below and show its cut off frequency is $W_c = 1/R_0$

Solu
This is a low pass filter. A typical low pass filter is formed when the output of an AC circuit is taken off the capacitor

from diagram R



Converting to frequency domain
$R \rightarrow R$, $C \Rightarrow 1/jwC$, $H(w) = V_0/V_i$
using kirchoff voltage law

$$H(w) = \frac{V_0}{V_i} = \frac{1/jwc}{R + 1/jwc} \Rightarrow \frac{1}{1 + jwRc}$$

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

The half power frequency which is equivalent to the corner frequency on the bode plot is obtained by setting magnitude of $H(\omega) = 1/\sqrt{2}$

Substituting $|H(\omega)| = 1/\sqrt{2}$

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

Taking square

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

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

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

Square rooting both sides

$$1 = \omega_c RC$$

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