Special Homework

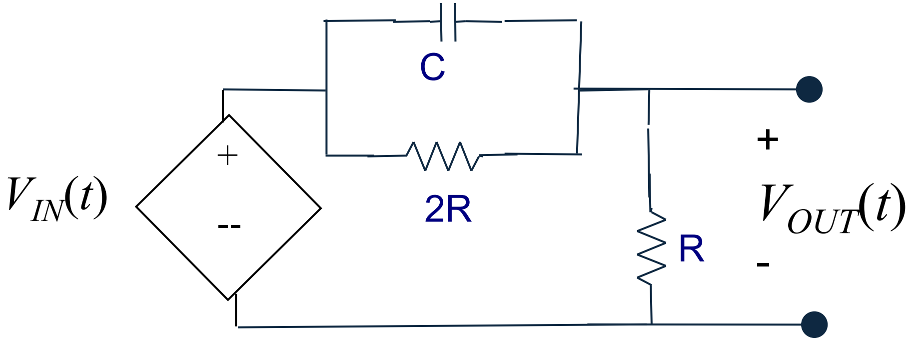
For the following circuit:

a) Determine and sketch the transfer function in ***polar form.***

b) Assume that R=1 and C=2, sketch the transfer function versus the ***frequency, f***; i.e. ***in Hertz***.

c) What sort of circuit is this?

d) What is its cutoff frequency?



Exam 2

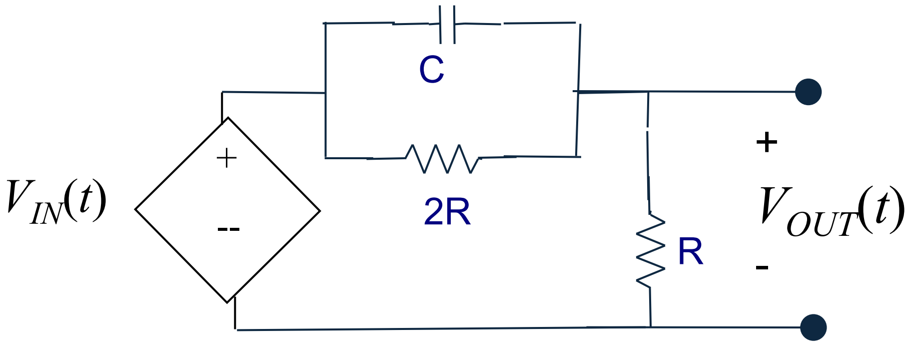
5. For the following circuit:

a) Determine the transfer function in ***polar form***

b) Assume that R=1 and C=2, sketch the transfer function versus the ***frequency, f***; i.e. ***in Hertz***.

c) What sort of circuit is this?

d) What is its cutoff frequency?



$$a)\ \frac{V_{out}}{V_{in}} = \frac{R}{Z_{ab}}$$

$$Z_{ab} = \frac{3R + j\omega 2R^2C}{1 + j\omega 2RC}$$

$$\frac{V_{out}}{V_{in}} = \frac{R}{\frac{3R + j\omega 2R^2C}{1 + j\omega 2RC}} = \frac{R(1 + j\omega 2RC)}{3R + j\omega 2R^2C} = \frac{(1 + j\omega 2RC)}{3 + j\omega 2RC}$$

$$\text{Let } \omega{=}2\pi f \text{ and } f_o = \frac{1}{2\pi 2RC} = 0.039$$

$$= \frac{1 + j\frac{f}{f_o}}{3 + j\frac{f}{f_o}} = \frac{\sqrt{1 + (\frac{f}{f_o})^2} \angle \tan^{-1}(\frac{f}{f_o})}{\sqrt{3^2 + (\frac{f}{f_o})^2} \angle \tan^{-1}(\frac{f}{3f_o})} = \frac{\sqrt{1 + (\frac{f}{f_o})^2}}{\sqrt{3^2 + (\frac{f}{f_o})^2}} \angle \tan^{-1}(\frac{f}{f_o}) - \angle \tan^{-1}(\frac{f}{3f_o})$$

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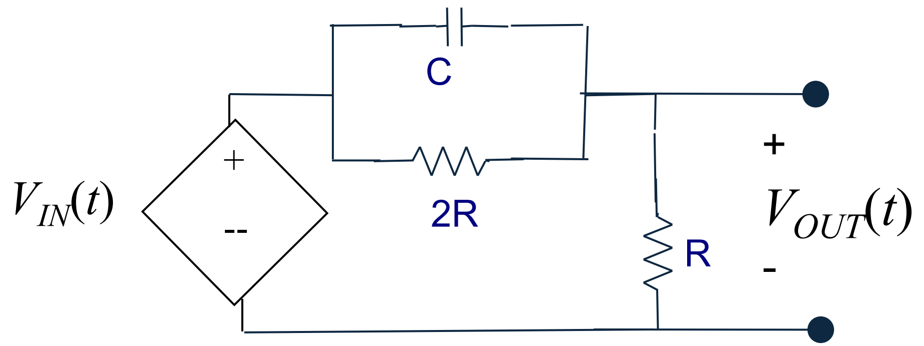

$c)$ HPF

$d)$ from the graph the cutoff frequency is around $f = .1$ Hz; Note that f_o is not the cutoff frequency since the value of $\frac{V_{out}}{V_{in}}$ is not equal $\frac{1}{\sqrt{2}} \times \frac{V_{out}}{V_{in}}|_{\max} = \frac{1}{\sqrt{2}} = 0.707$ but equal to 0.45.

$$b)\ \frac{V_{out}}{V_{in}} = \frac{1+j\frac{f}{f_o}}{3+j\frac{f}{f_o}}$$

$$\frac{V_{out}}{V_{in}}|_{f=0} = \frac{1+j\frac{0}{f_o}}{3+j\frac{0}{f_o}} = \frac{1}{3}\angle 0$$

$$\frac{V_{out}}{V_{in}}|_{f\to\infty} \to \frac{1+j\frac{f}{f_o}}{3+j\frac{f}{f_o}}|_{f\to\infty} \to \frac{j\frac{f}{f_o}}{j\frac{f}{f_o}} = 1\angle 0$$

$$\frac{V_{out}}{V_{in}}|_{f=f_o=0.039} = \frac{1+j\frac{f_o}{f_o}}{3+j\frac{f_o}{f_o}} = \frac{1+j1}{3+j1} = \frac{\sqrt{2}\angle\frac{\pi}{4}}{\sqrt{10}\angle\tan^{-1}(\frac{1}{3})} = \frac{1}{\sqrt{5}}\angle\frac{\pi}{4} - \tan^{-1}(\frac{1}{3}) = 0.045\angle 0.46$$