Problem Set III

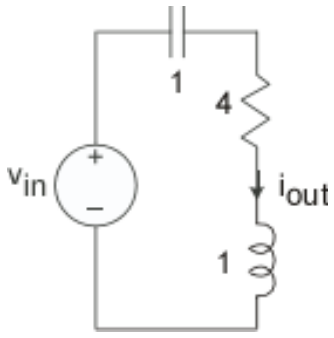
The **due date** for this homework is **Mon 11 Feb 2013 11:59 PM CST**.

In this problem set, you will only be given a total of three attempts. We will accept late submission until the fifth day after the due date, and late submission will receive half credit. Explanations and answers to the problem set will be available after the due date. Since the homework problems will become gradually more challenging as the course proceeds, we highly recommend you to start the habit of printing out the problems and working on them with paper and pencil. Also, please be sure to read the problem statements carefully and double check your expressions before you submit.

A pdf version of this problem set is available for you to print. Note: all mathematical expressions have to be exact, even when involving constants. Such an expression is required when a function and/or a variable is required in the answer. For example, if the answer is $\sqrt{3}x$, you must type `sqrt(3)*x`, not `1.732*x` for the answer to be graded as being correct.

Question 1

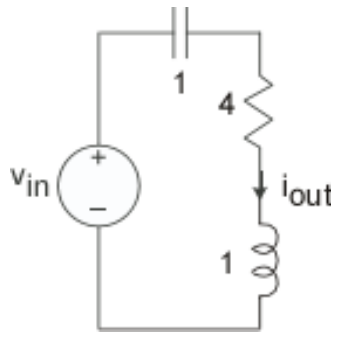
Find the transfer function relating the complex amplitudes of the indicated variable and the source. Use the symbol s to represent $j2\pi f$ and express your answer in terms of s.



Preview

Question 2

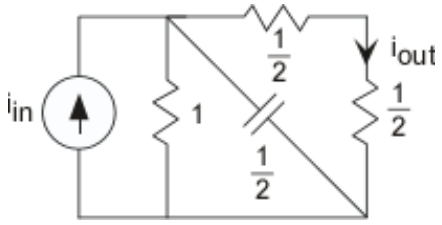
Re-writing the transfer function you found in the previous question in terms of $j2\pi f$, determine what kind of filter this circuit realizes.



- Lowpass
- Highpass
- Bandpass
- Something else

Question 3

In the following circuit, the output current $i_{\text{out}}(t)$ equals $\cos(2t)$.

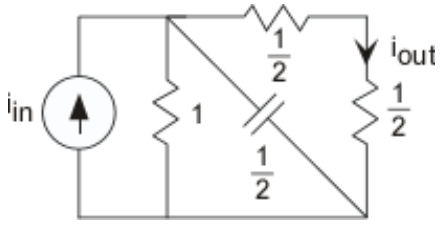


What is the frequency of the source? Write your answer as an expression, not a numeric quantity.

Preview

Question 4

In the following circuit, the output current $i_{\text{out}}(t)$ equals $\cos(2t)$.

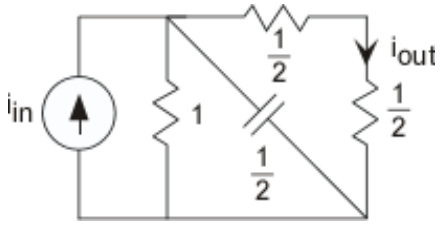


What is the transfer function between the source and the output current? Write your answer in terms of s, where $s = j2\pi f$.

Preview

Question 5

In the following circuit, the output current $i_{\text{out}}(t)$ equals $\cos(2t)$.



Find the source, expressed as a real-valued signal.

Preview

Question 6

In the lab, the open-circuit voltage measured across an unknown circuit's

terminals equals $\sin(t)$. When a 1Ω resistor is placed across the terminals, a voltage of $\frac{1}{\sqrt{2}}\sin\left(t+\frac{\pi}{4}\right)$ appears. What is the Thévenin equivalent source voltage? Express your answer as a real-valued signal.

Preview

Question 7

In the lab, the open-circuit voltage measured across an unknown circuit's terminals equals $\sin(t)$. When a 1Ω resistor is placed across the terminals, a voltage of $\frac{1}{\sqrt{2}}\sin\left(t+\frac{\pi}{4}\right)$ appears. What is the Thévenin equivalent impedance? Your answer can be in Cartesian or polar form.

Preview

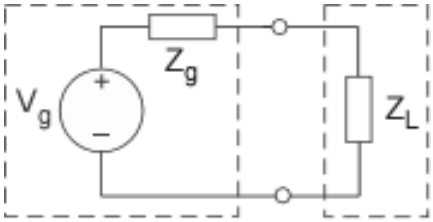
Question 8

In the lab, the open-circuit voltage measured across an unknown circuit's terminals equals $\sin(t)$. When a 1Ω resistor is placed across the terminals, a voltage of $\frac{1}{\sqrt{2}}\sin\left(t+\frac{\pi}{4}\right)$ appears. What voltage will appear if a 1F capacitor replaces the resistor?

Preview

Question 9

The following circuit shows a general model for power transmission. The power generator is represented by a Thévinin equivalent and the load by a simple impedance. In most applications, the source components are fixed while there is some latitude in choosing the load.



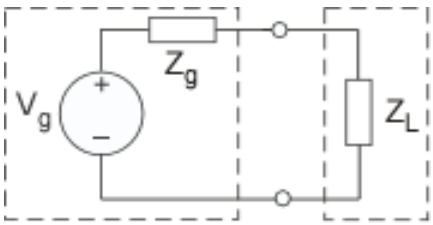
Suppose we wanted to maximize "voltage transmission": make the voltage across the load as large as possible. In this problem, the source is a sinusoid having some amplitude, frequency and phase. What choice of load impedance creates the largest load voltage? Enter your answer as a mathematical expression as `a+j*b`, entering **exact** values for a and b.

If needed, use `z_r` to represent z_r and `z_i` to represent z_i, the real and imaginary parts of the source impedance $Z_g = z_r + jz_i$. So, if $Z_L = Z_g$ is your answer, enter `z_r+j*z_i`.

Preview

Question 10

Suppose we wanted the maximize "current transmission:" make the voltage across the load as large as possible.



What choice of load impedance creates the largest load current?

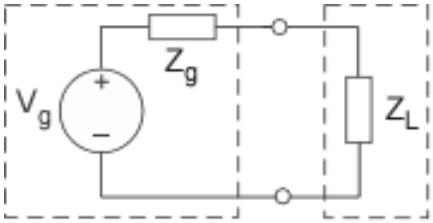
Use `z_r` to represent z_r and `z_i` to represent z_i, the real and imaginary parts of

the source impedance: $Z_g = z_r + jz_i$. So, if $Z_L = Z_g$ is your answer, enter `z_r+j*z_i`.

Preview

Question 11

What choice for the load impedance maximizes the average power dissipated in the load?



What choice of load impedance creates the largest load current?

Use `z_r` to represent z_r and `z_i` to represent z_i, the real and imaginary parts of the source impedance $Z_g = z_r + jz_i$. So, if $Z_L = Z_g$ is your answer, enter `z_r+j*z_i`.

Preview

In accordance with the Honor Code, I certify that my answers here are my own work.

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