Homework 9

Due date:
Jun 4th, 2018
Turn in your homework in class

Rules:

- Work on your own. Discussion is permissible, but extremely similar submissions will be judged as plagiarism.
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

1. Determine the resonant frequency of the circuit shown below.

   Given that R= 1kΩ, L = 10 mH, and C = 10nF.

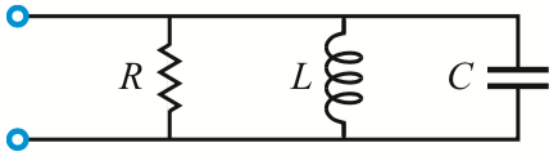

Figure 1

2. For the circuit shown below, determine the transform function $\mathbf{H}(\boldsymbol{\omega}) = \mathbf{V}_o/\mathbf{V}_i$,and determine the frequency $\boldsymbol{\omega}$ at which $\mathbf{H}(\omega)$ is purely real.

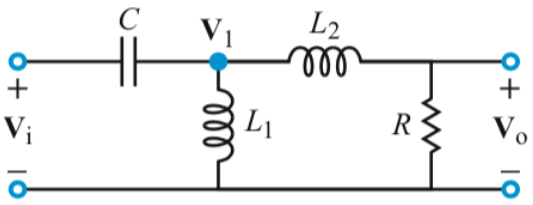

Figure 2

3. Generate Bode magnitude and phase plots for the following voltage transfer functions (with some necessary approximation for straight-line in drawing) (more space for drawing and enough annotation is necessary):

(a) $\mathbf{H}(\omega) = \dfrac{4\times 10^4(60+j6\omega)}{(4+j2\omega)(100+j2\omega)(400+j4\omega)}$

(b) $\mathbf{H}(\omega) = \dfrac{(1+j0.2\omega)^2(100+j2\omega)^2}{(j\omega)^3(500+j\omega)}$

(c) $\mathbf{H}(\omega) = \dfrac{8\times 10^{-2}(10+j10\omega)}{j\omega(16-\omega^2+j4\omega)}$

(d) $\mathbf{H}(\omega) = \dfrac{4\times 10^4\omega^2(100-\omega^2+j50\omega)}{(5+j5\omega)(200+j2\omega)^3}$

4. Determine the voltage transfer function **H(**ω**)** corresponding to the Bode magnitude plot shown below and corresponding information provided below:

   (a) The phase of **H(**ω**)** is 90° at $\omega = 0$ in Fig 4.1.

   (b) The phase of **H(**ω**)** is -90° at $\omega = 0$ in Fig 4.2.

   (c) The phase of **H(**ω**)** is 0° at $\omega = 0$ in Fig 4.3.

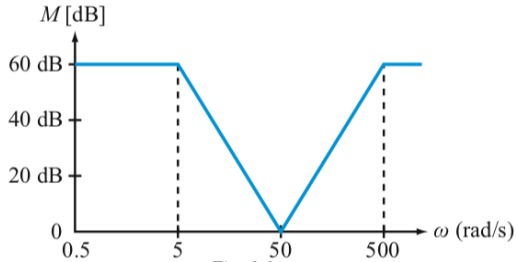

Fig 4.1

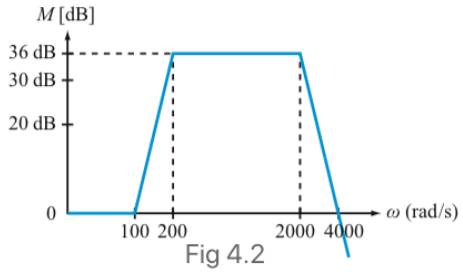

Fig 4.2

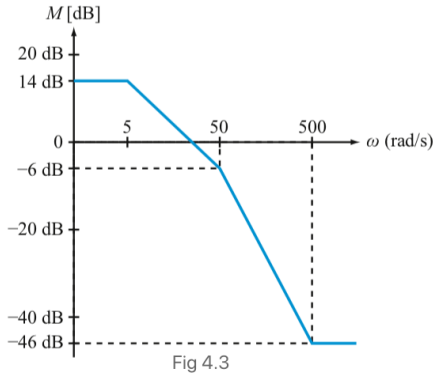

Fig 4.3

5. Determine the center frequency and bandwidth of the bandpass filters in Fig.5

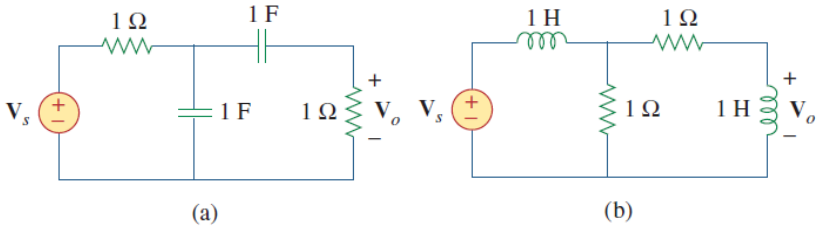

Figure 5

6. For the op-amp circuit of Fig. 6:
   (a) Obtain an expression for $\mathbf{H}(\omega) = \mathbf{V}_o/\mathbf{V}_s$ in standard form.
   (b) Generate spectral plots for the magnitude and phase of $\mathbf{H}(\omega)$, given that $R_1 = R_2 = 100\Omega$, and $C_1 = 10\mu F$, $C_2 = 0.4\mu F$.
   (c) What type of filter is it? What is its maximum gain?

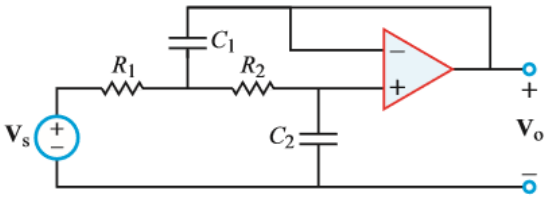

Figure 6

7. Design the filter in Fig. 7 to meet the following requirements, given R = 10k Ω:
   - It must attenuate a signal at 2 kHz by 3 dB compared with its value at 10 MHz.
   - It must provide a steady-state output of $v_o(t) = 10\sin(2\pi \times 10^8 t + 180^\circ)\,V$ for an input $v_s(t) = 10\sin(2\pi \times 10^8 t)V$.

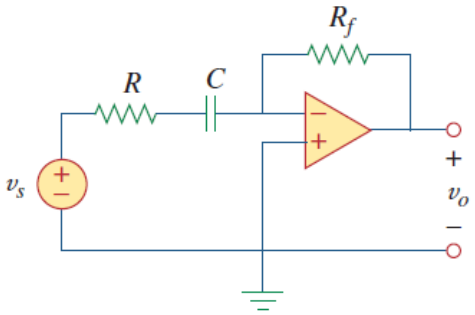

Figure 7

8. In the circuit shown below, find current $\mathbf{I}_0$.

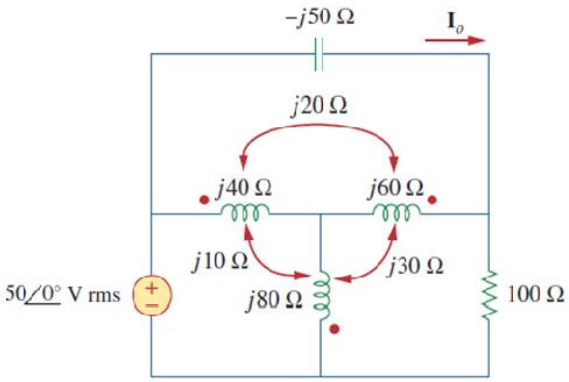

Figure 8

9. In the ideal transformer circuit shown below, determine the average power delivered to the load (the 20-j40Ω resistance).

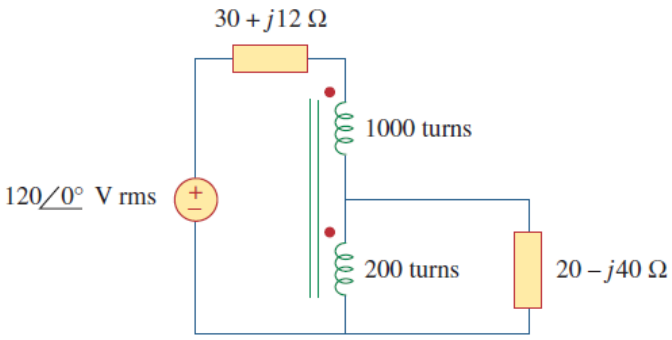

Figure 9