電路學(10410EE221002)期末考

2016年01月11日
時間：2 小時
Close Book

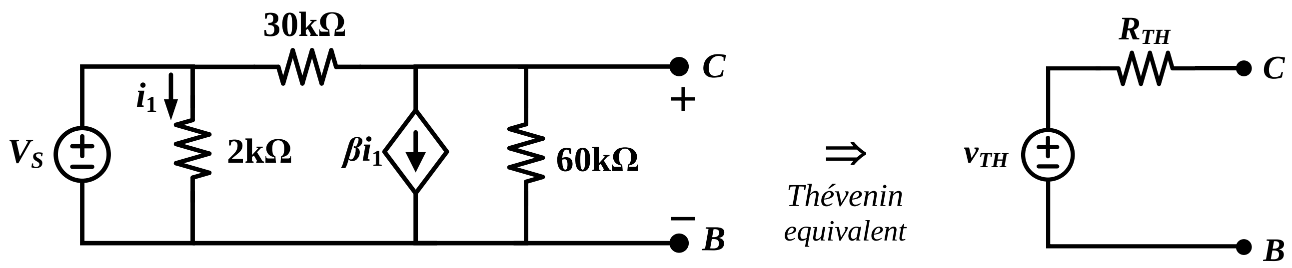
學號：______________________________

姓名：______________________________

- There are 12 pages in this final exam, including this cover page. Please check that you have them all.
- Please write your 學號 姓名 in the space provided above.
- **IMPORTANT:** The problems in this exam vary in difficulty; moreover, questions of different levels of difficulty are distributed throughout the exam. If you find yourself spending a long time on a question, consider moving on to later problems in the exam, and then working on the challenging problems after you have finished all of the easier ones.
- Do your work and enter your answer for each question within the boundaries of that question. You may do your work on the back of the preceding page.
- Remember to include the sign and units for all numerical answers.
- This is a closed-book exam, but you may use a calculator.
- You have 2 hours to complete this exam.
- Good luck! Have a Happy Winter Break and Chinese New Year!

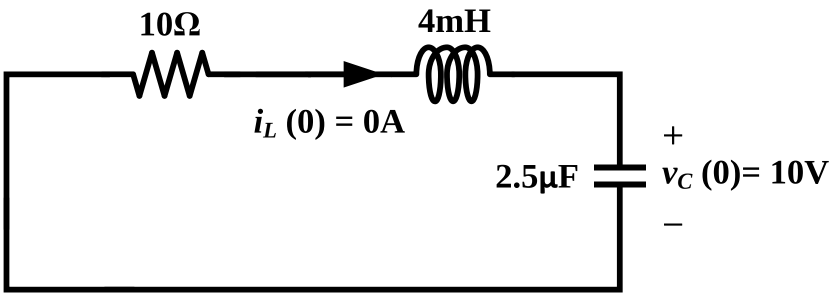
1.	**2.**	**3.**	**4.**	**5.**
6.	**7.**	**8.**	**9.**	**10.**
Total Grade:				

1. Find the Thévenin equivalent for the network at the terminals *CB*. (10%)



v_{TH} =_____________________________________, R_{TH} =_____________________________________.

2. For the following circuit as shown, assume the initial state of the capacitor $v_C(0)$ is 10V and that of inductor $i_L(0) = 0$ A, answer that following questions.



(1) Find the undamped natural frequence, ω_0. (2%)
(2) Find the damping factor, α. (2%)
(3) Find the approximate damped-natural frequence, ω_d. (1%)
(4) Find the approximate period of the ringing, T. (2%)
(5) Find the quality factor, Q. (1%)
(6) Find $v_C(0^+)$. (1%)
(7) Find $\frac{dv_C(0^+)}{dt}$. (1%)

ω_0 = ____________________, α = ____________________, $\omega_d \approx$ ____________________, $T \approx$ ____________________,

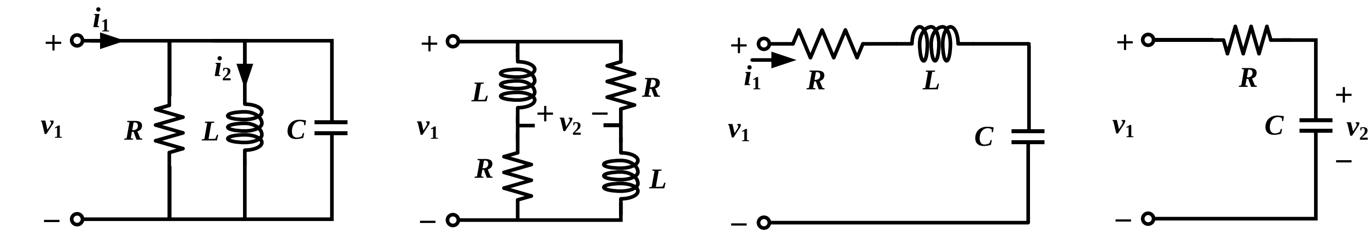
Q = ________________________, $v_C(0^+)$ = ________________________, $\frac{dv_C(0^+)}{dt}$ = ________________________,

3. For each of the circuits shown in the figure, select the magnitude of the frequency response for the system function (that is, impedance, admittance, or transfer function) from those given. It is not necessary to relate the critical frequencies to the circuit parameters, and you may choose a magnitude response more than once. Please note that the magnitude responses are sketched on a log-log scale, with slopes labeled. (10%)

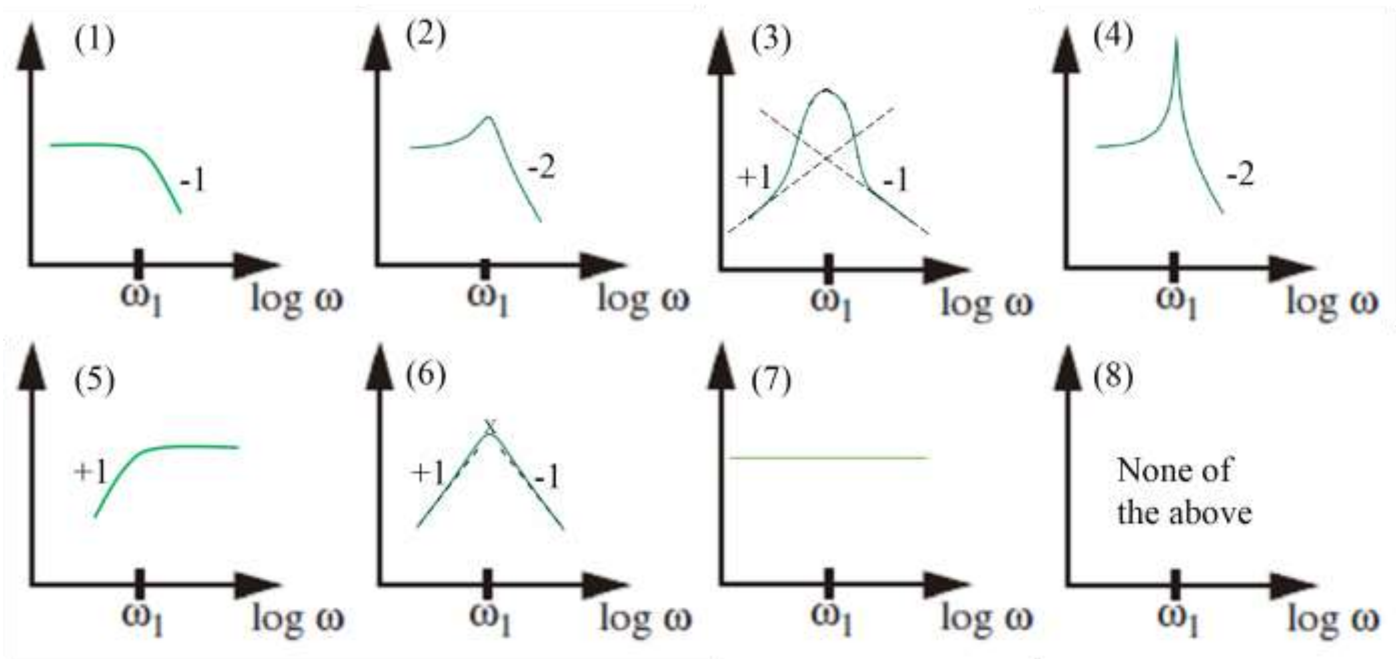
(a) **(b)** **(c)** **(d)**

(a) $R = 10\Omega$, $L = 0.1$ mH, $C = 1\mu$F

(c) $R = 5\Omega$, $L = 10$ mH, $C = 1\mu$F

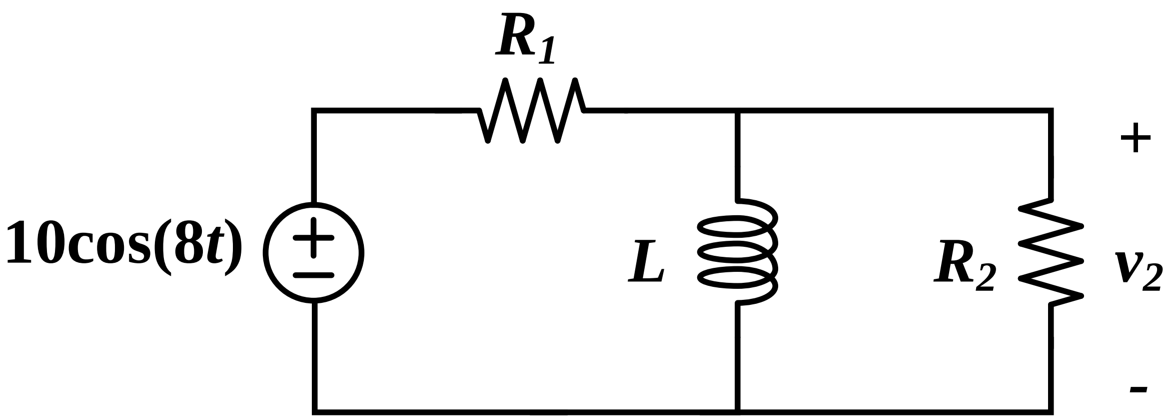


(a) $\mathbf{H}(j\omega) = \dfrac{\mathbf{I}_2(j\omega)}{\mathbf{I}_1(j\omega)}$ (b) $\mathbf{H}(j\omega) = \dfrac{\mathbf{V}_2(j\omega)}{\mathbf{V}_1(j\omega)}$ (c) $\mathbf{Y}(j\omega) = \dfrac{\mathbf{I}_1(j\omega)}{\mathbf{V}_1(j\omega)}$ (d) $\mathbf{H}(j\omega) = \dfrac{\mathbf{V}_2(j\omega)}{\mathbf{V}_1(j\omega)}$



(a) → ________________, (b) → ________________, (c)→ ________________, (d)→ ________________.

4. Find $v_2(t)$ in the sinusoidal steady state for the following circuit, assuming L = 5 H, R_1 = 200 Ω, and R_2 = 50 Ω. (10%)



$v_2(t)$ = ____.

5. The circuit in figure (1) is to be used as a bandpass filter having the magnitude-frequency curve shown in Figure (2) (linear coordinates). The input voltage is $v_s(t) = V_s \cos(\omega t)$, $\omega_c = 1 \times 10^6$ rad/s, $\omega^+ = 1.05 \times 10^6$ rad/s, and $\omega^- = 0.95 \times 10^6$ rad/s

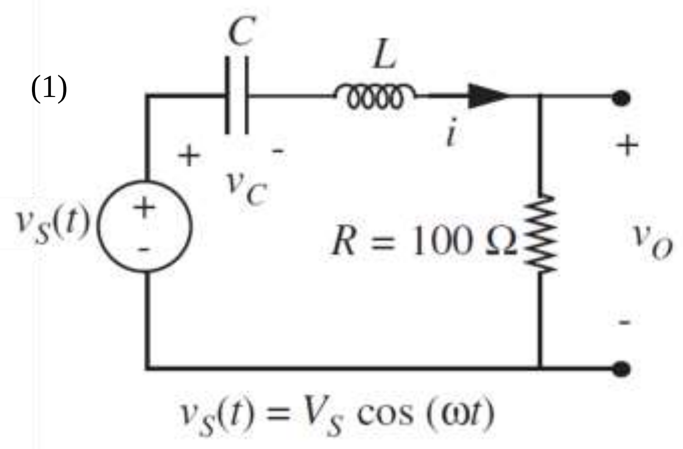
   (a) Sketch $\angle V_o$ vs. ω. (3%)

   (b) Find the appropriate values of L and C. (2%)

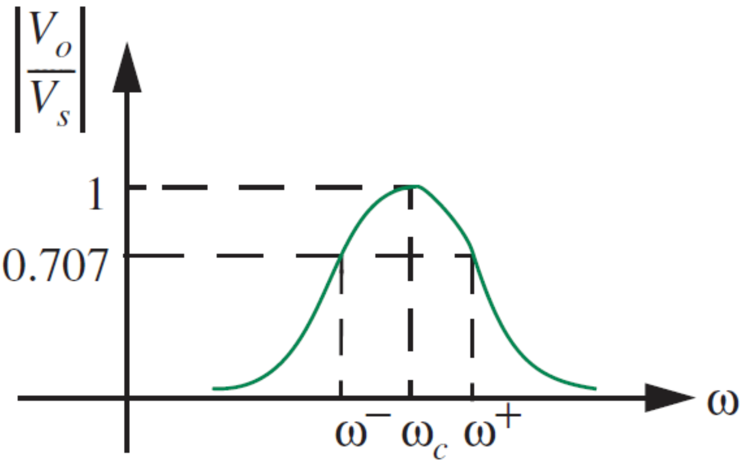
   (c) Let $v_S = 10\text{V} \cos 10^6 t$. Calculate $v_C(t)$, $i(t)$, and $v_O(t)$. (3%)

   (d) For $v_S = 10\text{V} \cos 10^6 t$, determine the total stored energy W_s and the time-averaged power dissipated. (2%)

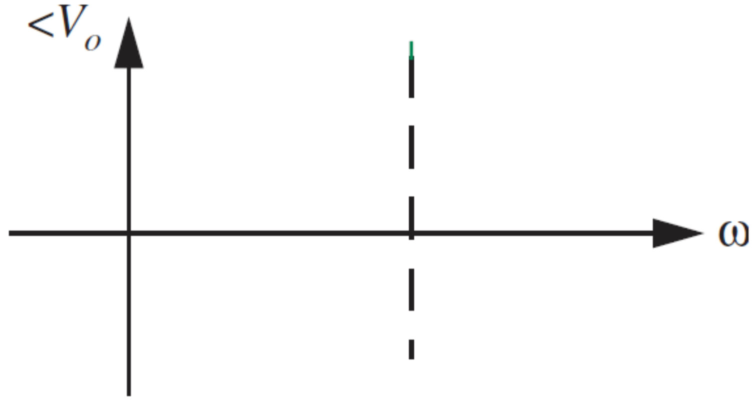
(1)



(2)



(a) $<V_o$



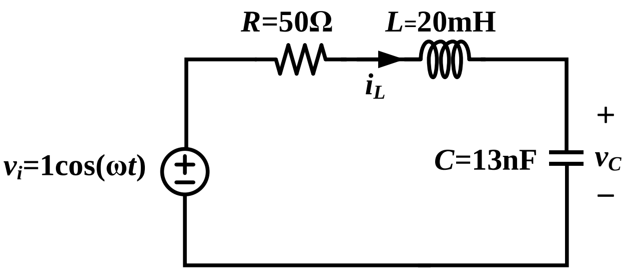
(b) L = ______________________, C = ______________________.

(c) $v_C(t)$ = ______________, $i(t)$ = ______________, $v_O(t)$ = ______________,

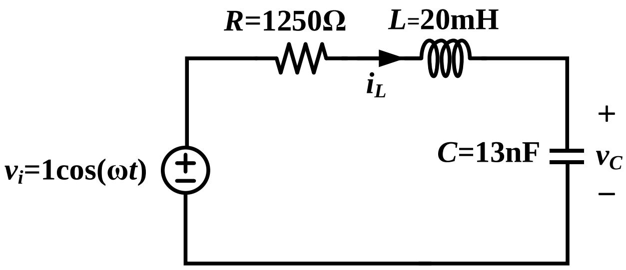
(d) W_s = ______________________, $\bar{p}$ = ______________________

6. For the two RLC circuits as shown in (a) and (b), find the frequency-domain response $\mathbf{V}_C(j\omega)/\mathbf{V}_i(j\omega)$ and the zero-input time-domain response $v_C(t)$ with $v_C(0) = -1$V by matching the correct plot from (1) to (8). (10%)

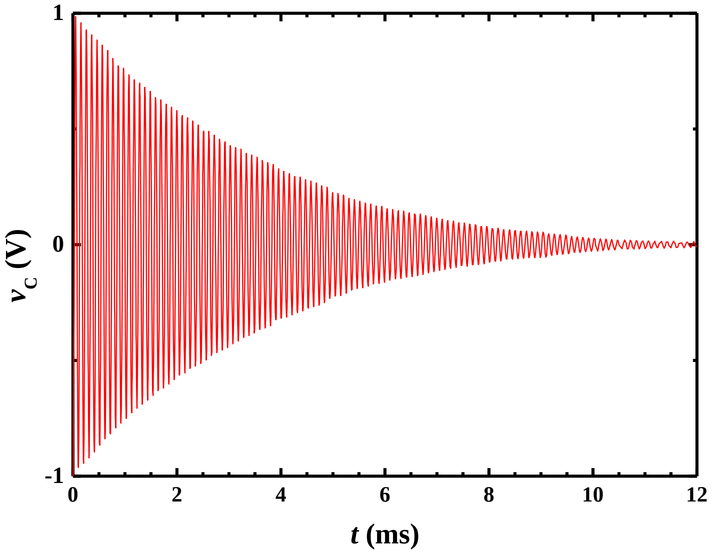
(a)



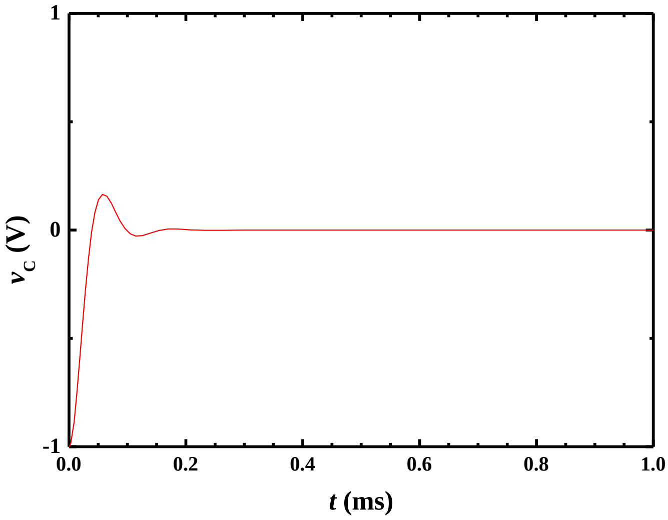
(b)



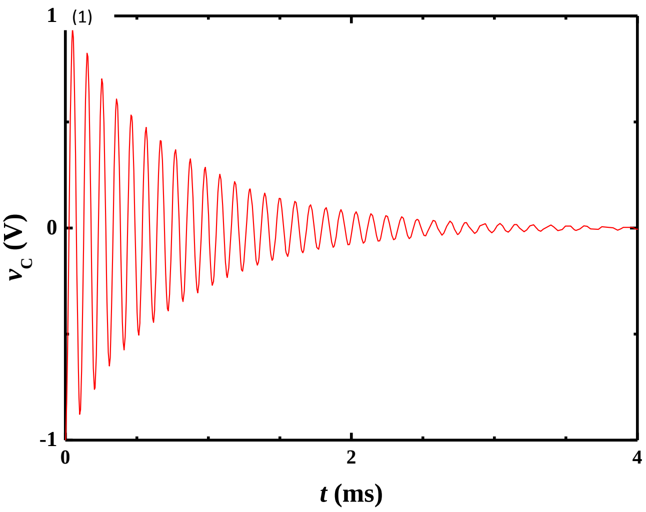
(1)



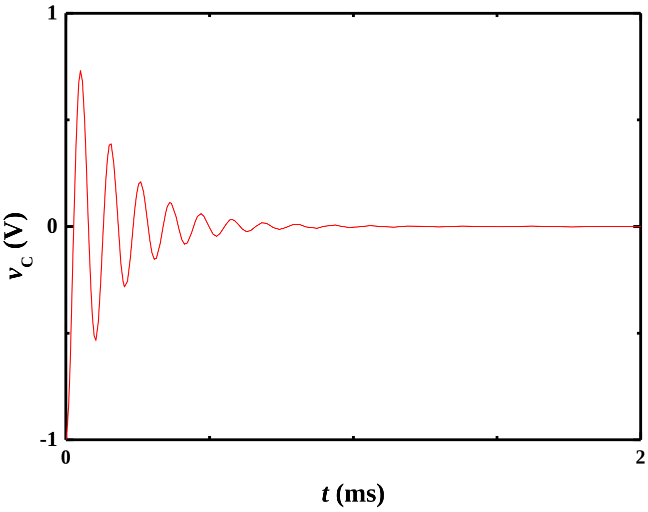
(2)

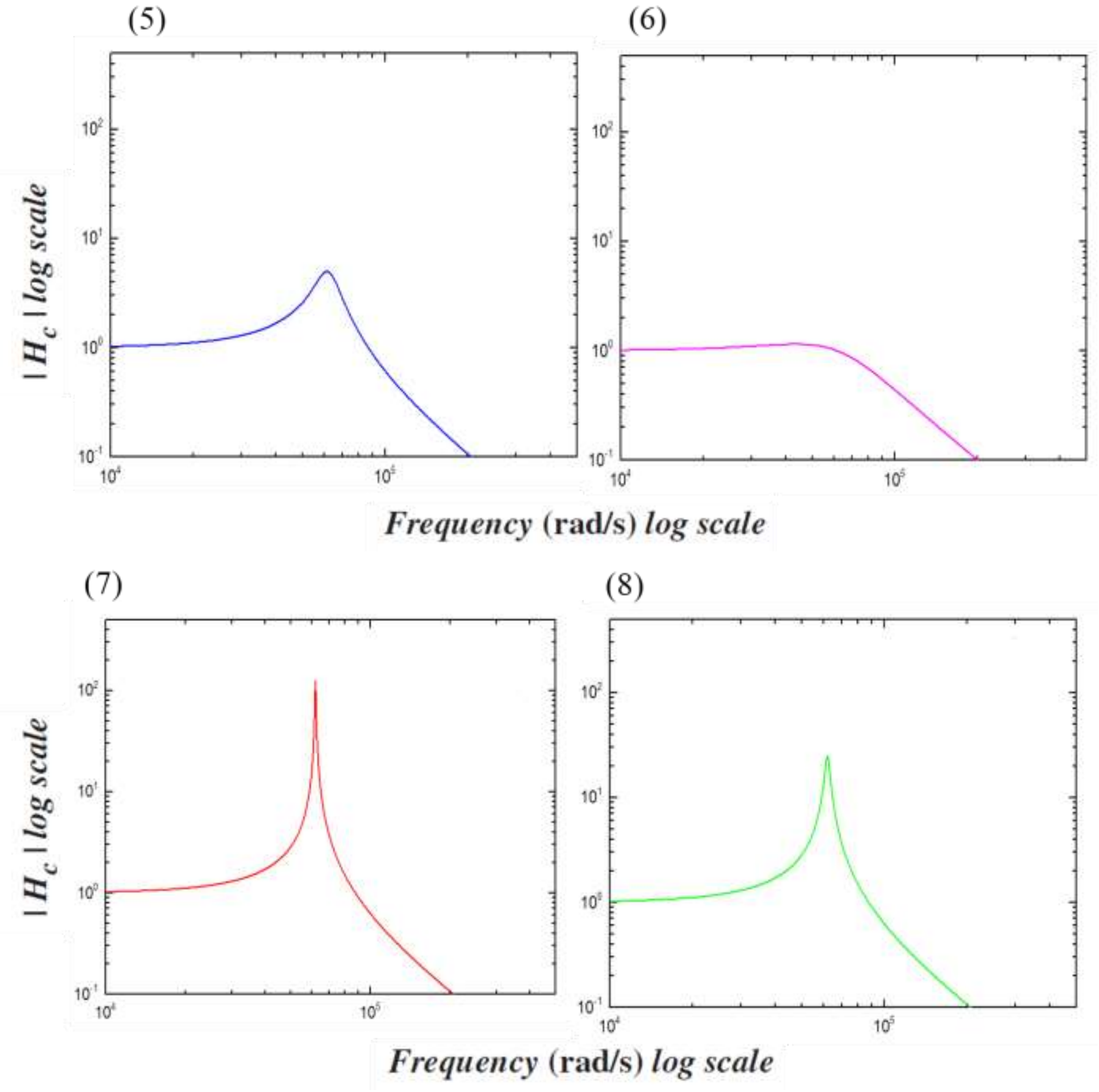


(3)



(4)

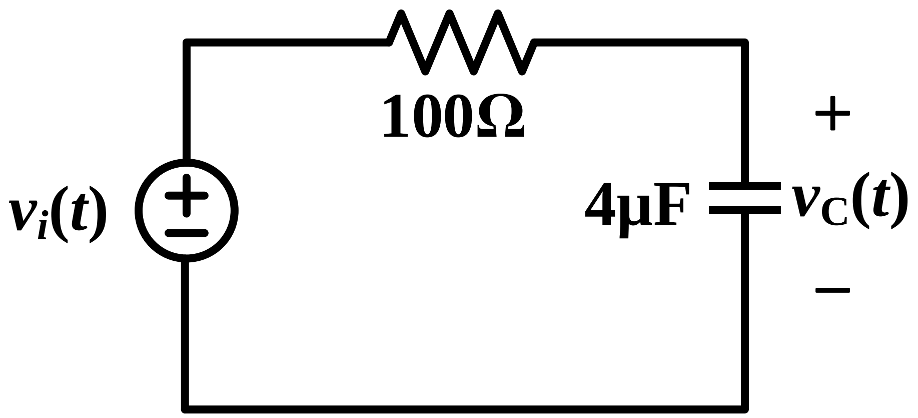




(5)
(6)
(7)
(8)
| H_c | log scale
Frequency (rad/s) log scale
10^2
10^1
10^0
10^-1
10^4
10^5

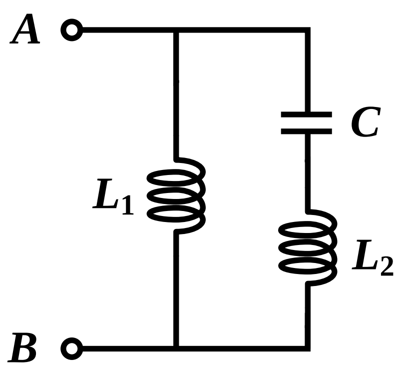
(a) → ________________, ________________, (b)→ ________________, ________________.

7. Find the time average power delivered by the ideal voltage source in the circuit if $v_i(t)$=4V cos(2500t+ 15°). (10%)



$\bar{p}$ = ____________________

8. Find the impedance and frequencies between terminal A and B. (10%)



(a) Find the impedance between terminal A and B at frequency ω.
(b) Find the frequency ω_{01} at which the impedance between terminal A and B is zero.
(c) Find the frequency ω_{02} at which the admittance between terminal A and B is zero.
(d) Find the frequency ranges at which the impedance between terminal A and B behave like an inductor.
(e) Find the frequency ranges at which the impedance between terminal A and B behave like an capacitor.

(a) $\mathbf{Z_{AB}}\,(j\omega)$ = ____________________,

(b) ω_{01} = ____________________, (c) ω_{02} = ____________________,

(d) ____________________, (e) ____________________.

9. Choose values for R_1 through R_5 in the following figure when the R_6 = 30 kΩ (10%)

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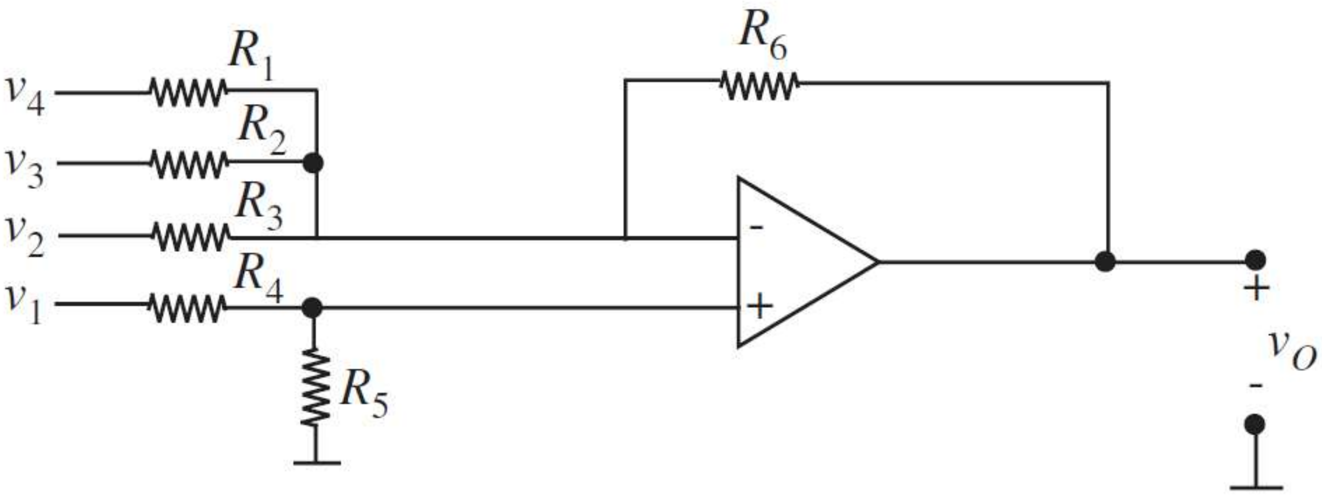
$$v_O = +2v_1 - 5v_2 - v_3 - 3v_4$$



R_1 = ______________________________,	R_2= ______________________________.
R_3 = ____________________, R_4 = ____________________,	R_5 = ____________________.

10. For the active filter circuit along with its impedance model (where s is a shorthand notation for $j\omega$) as shown in the following figures, (10%)

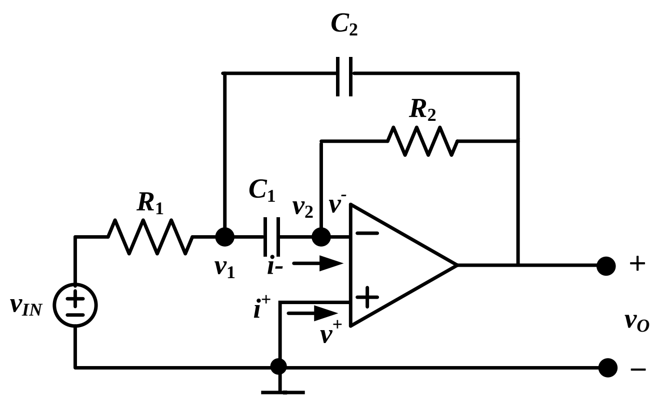
(a) Find the node equations for $\mathbf{V_1}$ and $\mathbf{V_2}$ by using the ideal Op Amp assumptions in the impedance model, that is, $\mathbf{V}^- \approx \mathbf{V}^+$ and $\mathbf{I}^- = \mathbf{I}^+ \approx 0$.

(b) Find the transfer function $\mathbf{H}(j\omega) = \mathbf{V_O}(j\omega)/\mathbf{V_{IN}}(j\omega)$ for this circuit.

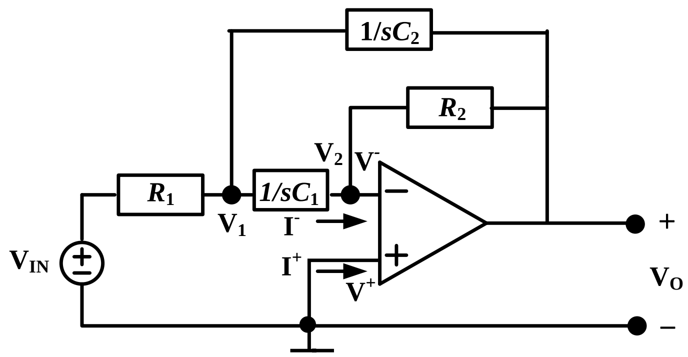
(c) Find the undamped natural frequency ω_0 and the quality factor Q of the circuit by using the following numerical values:

$C_1 = 0.06\ \mu\text{F},\ C_2 = 0.03\ \mu\text{F},\ R_1 = \frac{10}{9}\ \Omega,\ R_2 = 500\ \Omega$

(1) Circuit



(2) Impedance model



(a) Node $\mathbf{V_1}$: ______________________________,

Node $\mathbf{V_2}$: ______________________________,

(b) $\mathbf{H}(j\omega)$ = ______________________________,

(c) ω_0 = ______________, Q = ______________