電路學(EE2210)期末考

2014年1月15日
時間：2 小時
Close Book

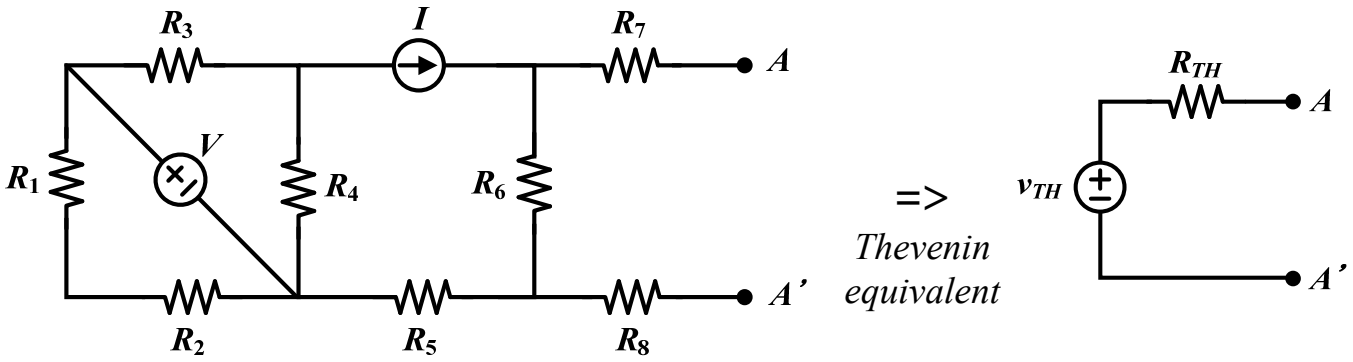
學號：_____

姓名：_____

- There are 11 pages in this midterm 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 Chinese New Year!

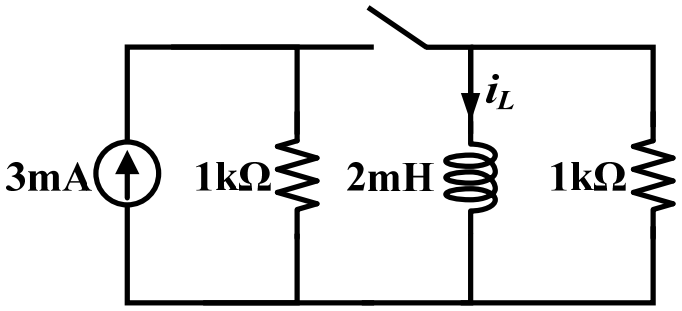
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
Total Grade:				

1. Find the Thévenin equivalent of the circuit for the terminals marked *AA'*. (10%)



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

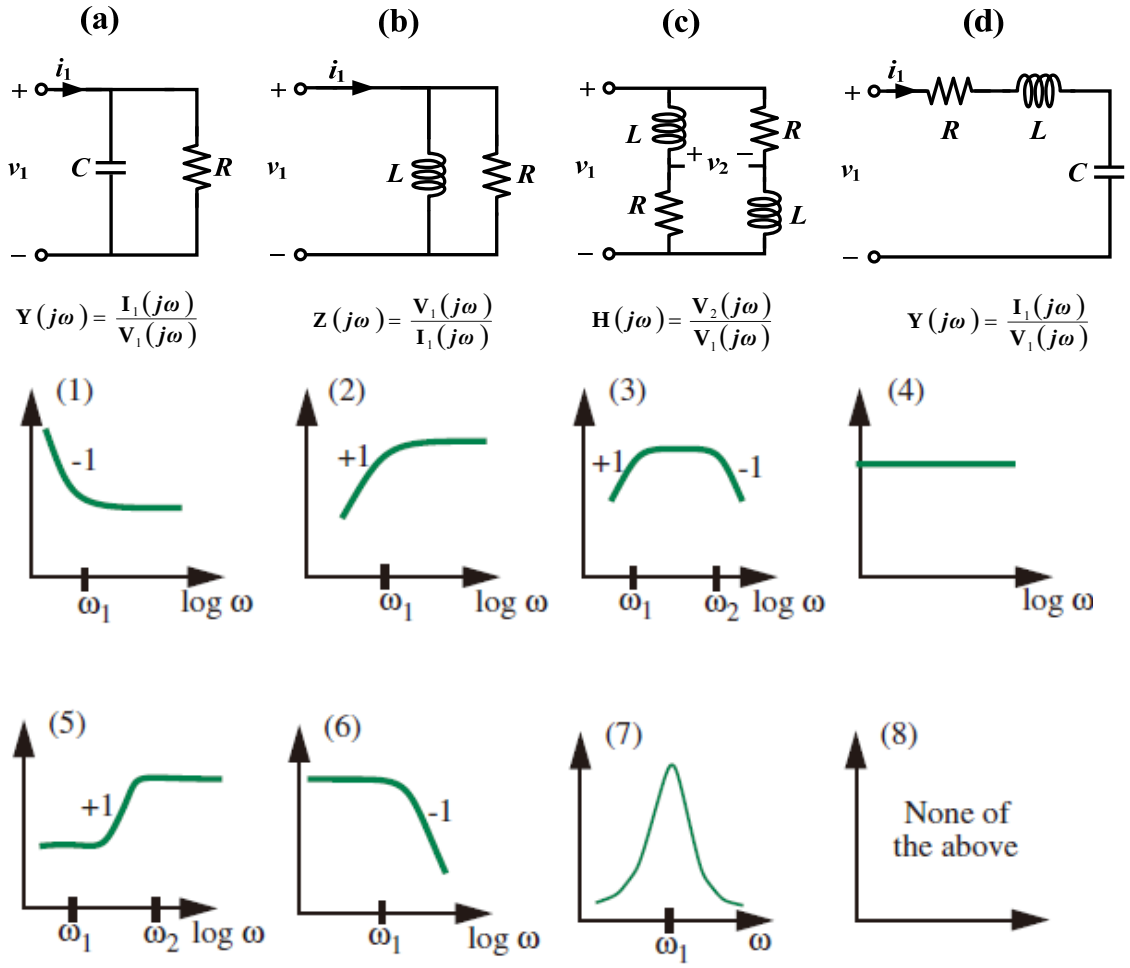
2. For the circuit as shown, the switch was closed at time $t = 0$ and opened at $t = 1$ second. Find $i_L(t)$ for $t \geq 0$. (10%)



$\tau(0 < t < 1) =$ _____, $\tau(t > 1) =$ _____,

$i_L(t) =$ _____.

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, except (7), are sketched on a log-log scale, with slopes labeled. (10%)



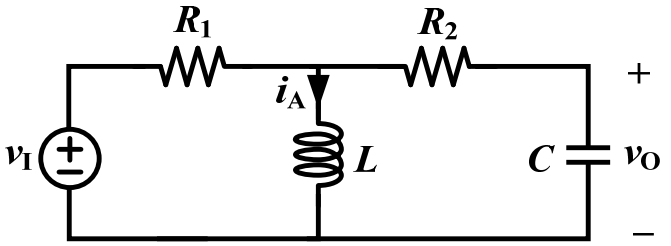
(a) → _____, (b) → _____, (c)→ _____, (d)→ _____.

4. The natural response of an RLC network is given by: $v_O(t) = 25e^{-5t}\cos(12t + \pi/7)$ V. Find (a) the undamped natural frequency ω_0, (b) the damping factor α, (c) the damped natural frequency ω_d, and (d) the quality factor Q. (10%)

(a) $\omega_0 =$ _____, (b) $\alpha =$ _____,

(c) $\omega_d =$ _____, (d) $Q =$ _____.

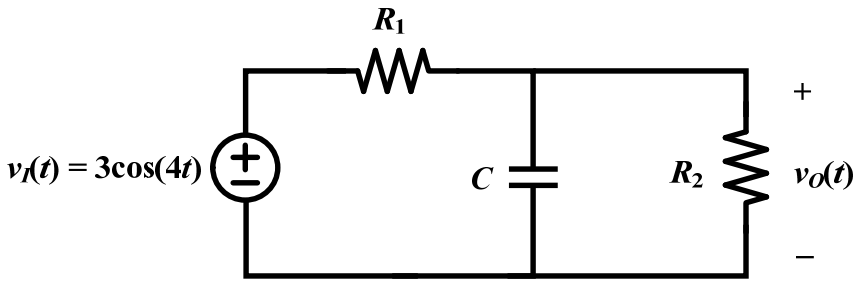
5. Write the transfer functions $\mathbf{V_o}(j\omega)/\mathbf{V_i}(j\omega)$, $\mathbf{I_a}(j\omega)/\mathbf{V_i}(j\omega)$ in the circuit as shown in the following figure. (10%)



$$\frac{\mathbf{V_o}(j\omega)}{\mathbf{V_i}(j\omega)} = \underline{\qquad\qquad},$$

$$\frac{\mathbf{I_a}(j\omega)}{\mathbf{V_i}(j\omega)} = \underline{\qquad\qquad}.$$

6. Find the transfer function in the frequency domain, and the $v_O(t)$ in the sinusoidal steady state for the following circuit. Assume $C = 0.25\text{mH}$, $R_1 = 3\text{k}\Omega$, and $R_2 = 1.5\text{k}\Omega$. (10%)



(1) $\mathbf{V_i} =$ _____,

(2) $\mathbf{H}(j\omega) = |\mathbf{H}|\angle\phi$

where $|\mathbf{H}|$ = _____, and ϕ = _____,

(3) $\mathbf{V_o} =$ _____,

(4) $v_o(t) =$ _____.

7. For the amplifier circuit as shown in Fig. (a), express all four parameters (i.e. R_{in}, R_{12}, R_{21}, R_{out}) of the Z parameter model in terms of R_1, R_2, and β. (Assuming $\beta \neq -1$.) (10%)

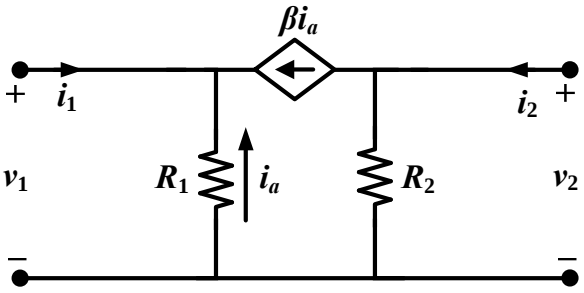
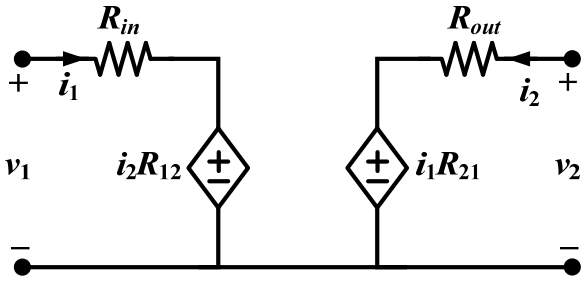


Fig. (a)



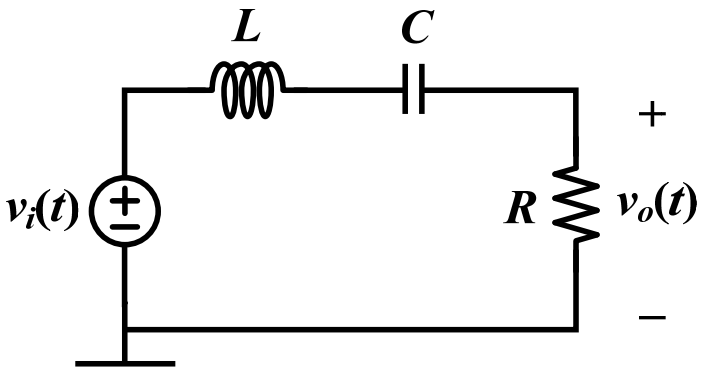
Z parameter model: $v_1 = i_1 R_{in} + i_2 R_{12}$

$v_2 = i_1 R_{21} + i_2 R_{out}$

R_{in} = _____, R_{12} = _____,

R_{21} = _____, R_{out} = _____.

8. In the network as shown, R = 1kΩ, L = 0.5mH, and C = 0.2μF. (10%)

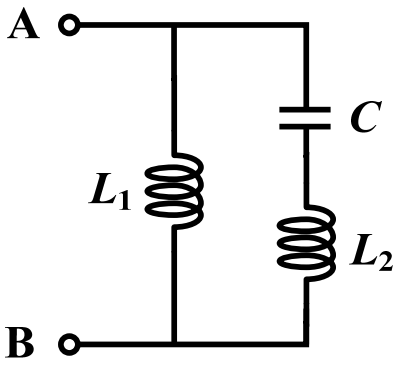


(a) Determine the magnitude and phase of $\mathbf{H}(j\omega)$, the transfer function relating $\mathbf{V_0}/\mathbf{V_i}$.
(b) Given $v_i(t) = \cos(100t) + \cos(100000t)$ V, determine the sinusoidal steady state output voltage, $v_o(t)$.

(a) $|\mathbf{H}(j\omega)| =$ _____, $\angle\mathbf{H}(j\omega) =$ _____,

(b) $v_o(t) =$ _____.

9. Find the frequency ranges at which the reactance between terminal A and B behave like an inductance. (10%)



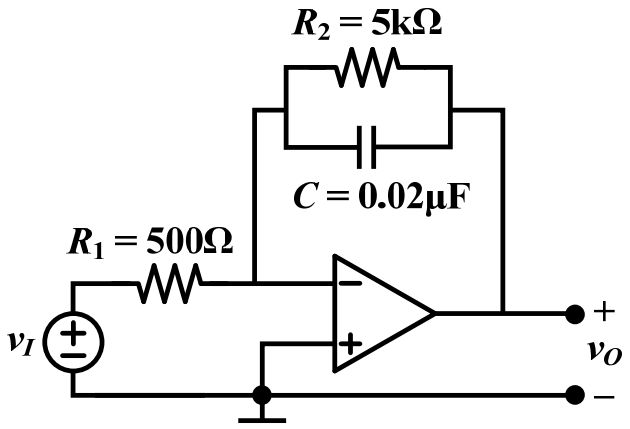
(a) Find the impedance between terminal A and B at frequency ω.
(b) Find the frequency ω_0 at which the impedance between terminal A and B is zero.
(c) Find the frequency ranges at which the impedance between terminal A and B behave like an inductor.
(d) Find the frequency ranges at which the impedance between terminal A and B behave like an capacitor.

(a) $\mathbf{Z_{AB}}$ = _____, (b) ω_0 = _____,

(c) _____, (d) _____.

10. An operational amplifier is connected in a circuit as shown. (10%)
(a) What is the gain of the amplifier for $\omega = 0$?
(b) Find the transfer function $\mathbf{H}(j\omega) = \mathbf{V_0}(j\omega)/\mathbf{V_i}(j\omega)$.

(c) Find the 3dB cornor frequency $\omega_{\text{-3dB}}$ at which $|\mathbf{V_o}|$ fall to 0.707 of its low-frequency value.



(a) Gain: $\left.\dfrac{v_O}{v_I}\right|_{\omega=0}$ = _____,

(b) $\mathbf{H}(j\omega) = \dfrac{\mathbf{V_o}(j\omega)}{\mathbf{V_i}(j\omega)}$ = _____,

(c) $\omega_{-3\text{dB}}$ = _____.