電路學(EE2210)第二次期中考

2013年12月9日
時間：2.5 小時
Close Book

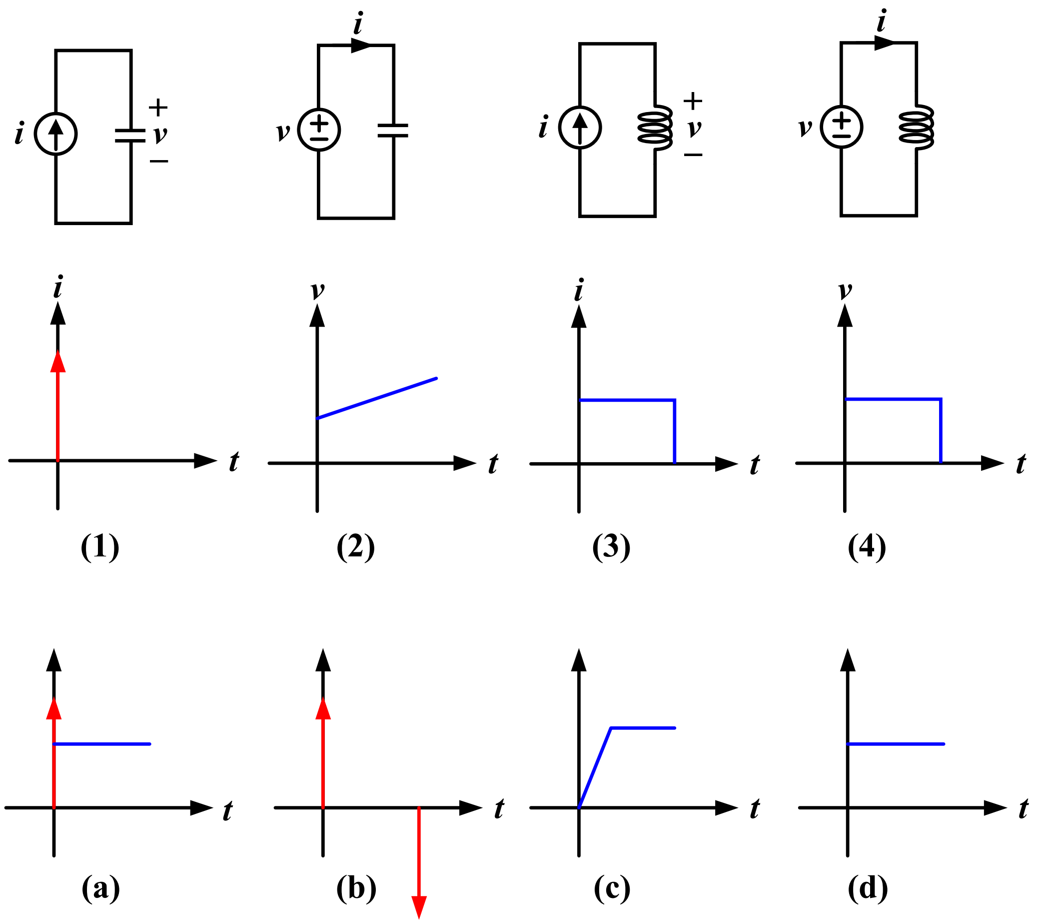
學號：________________________________

姓名：________________________________

- There are 12 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 2.5 hours to complete this exam.
- Good luck!

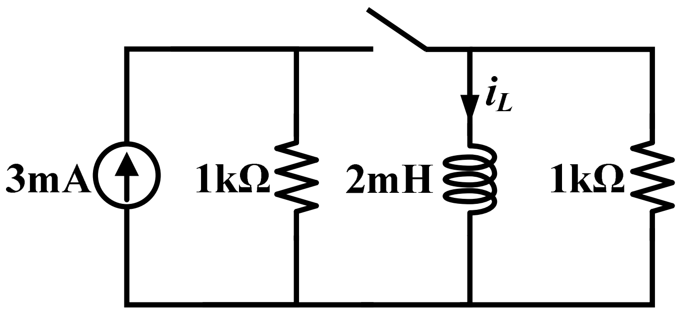
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
Total Grade				

1. The following figures show four circuits, labeled "(1)" through "(4)", together with the waveform for the source in each circuit. The figures also show four branch-variable waveforms, labeled "(a)" through "(d)", that could correspond to branch currents *i* or branch voltages *v* labeled in circuits. Match the branch variable waveform (a to d) to the appropriate circuit and source waveform (1 to 4). (8%)



(1) → _______________, (2) → _______________, (3) → _______________, (4) → _______________.

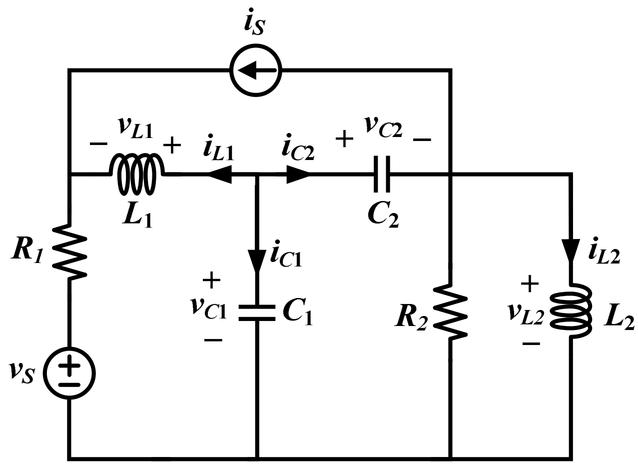
2. For the circuit as shown, the switch was closed at time $t = 0$ and opened at $t = 1$ second. Find $i_L(t)$ for $t \geq 0$. (8%)



$\tau(0 < t < 1) =$ ____________________________(2%), $\tau(t > 1) =$____________________________(2%),

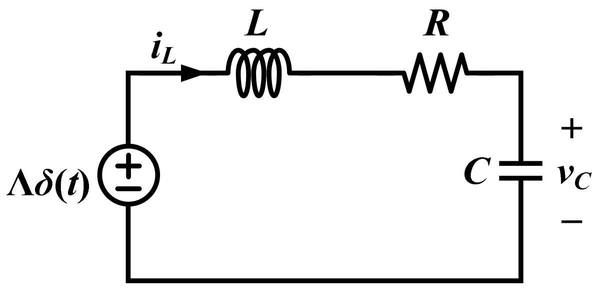
$i_L(t) =$ ____(4%).

3. Find the 1st order differential equation for state i_{L1} in the circuit (as shown in the following figure) in state-variable form (i.e. in terms of v_{C1}, v_{C2}, i_{L1}, i_{L2}, v_S and i_S) (8%)



$$L_1 \frac{di_{L1}}{dt} = \underline{\hspace{10cm}}.$$

4. For the circuit as shown, derive the 2nd order differential equation for v_C. Find the voltage $v_C(t)$ of the circuit for $t \geq 0$, assuming that $v_C(0^-) = 0$ and $i_L(0^-) = 0$. Please express your answer in terms of Λ, R, L, and C. (8%)

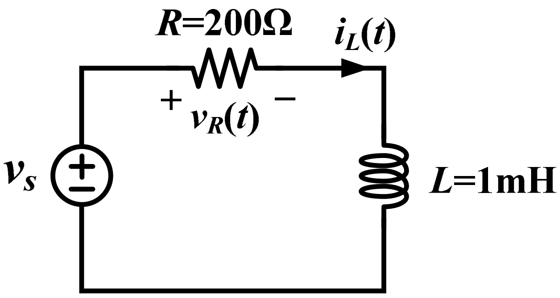


$\alpha =$ ______________________________ (1%), $\omega_0 =$ ______________________________ (1%),

$v_C(0^+) =$ ______________________________ (1%), $i_L(0^+) =$ ______________________________ (1%),

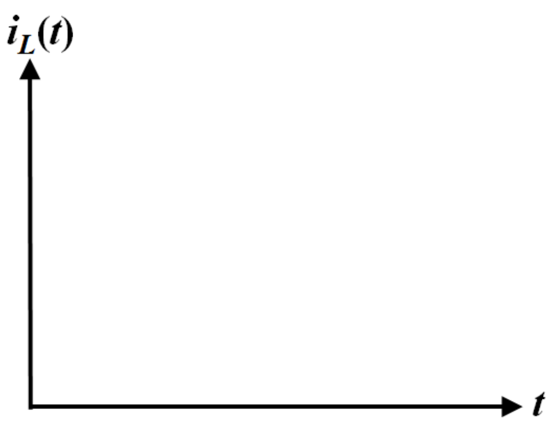
$v_C(t) =$ ____ (4%).

5. For the circuit as shown, find and sketch the zero state response $i_L(t)$ for $t \geq 0$. v_S is a 10V step at $t = 0$. (8%)



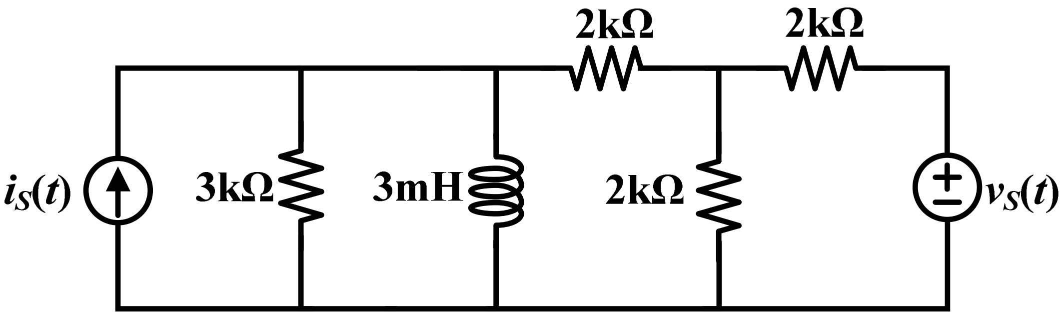
τ = ______________________________(1%),

$i_L(t)$ = ____(4%),



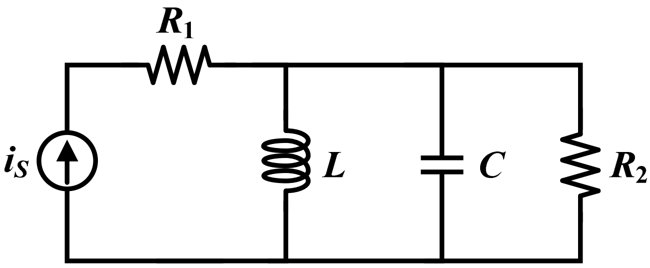
(3%),

6. Find the time constant τ of the circuit as shown. (8%)



τ = ____.

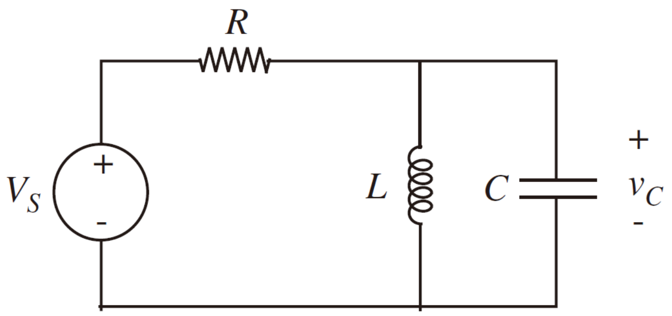
7. Is the zero-input response of the following circuit under-damped, over-damped, or critically-damped assuming L = 5mH, C = 0.5μF, and $R_1 = R_2$ = 200 Ω? (8%)



α = ________________(3%), ω_0 = ________________(3%),

Answer: ________________________________(2%).

8. For the circuit as shown with L = 1mH, C = 0.1 μF and R = 200Ω, Find and sketch the zero input response $v_C(t)$ with $v_S(t) = 5–5u(t)$ V. (16%)

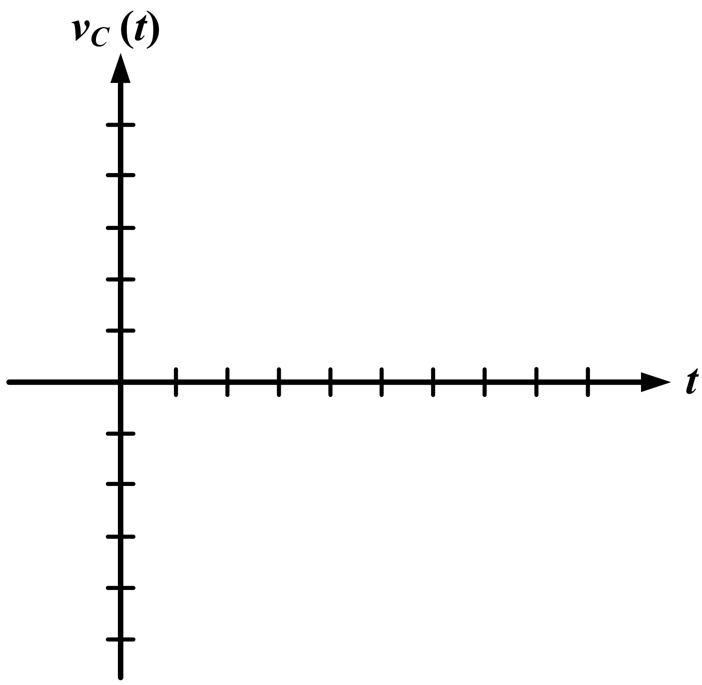


Solutions:

$v_C(0^+)$ = ______________(1%), $v_C(\infty)$ = ______________(1%), α = __________________(2%),

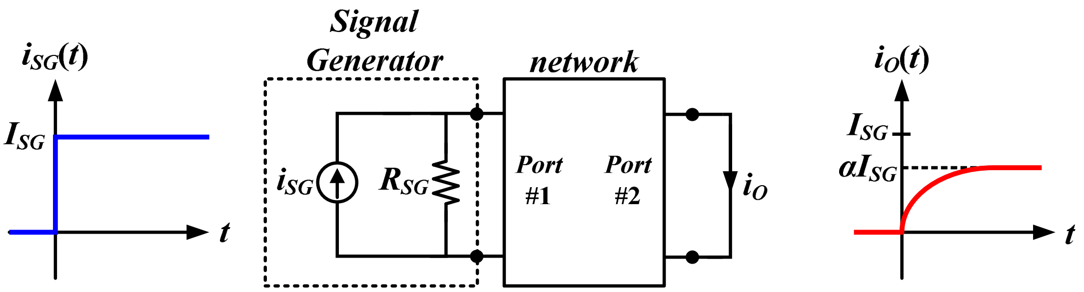
ω_0 = ________________(2%), $\omega_d \approx$ ________________(1%), T (period) ≈ _____________(1%),

$\frac{dv_C(0^+)}{dt}$ = ____________________________(2%), Q = ____________________________(2%),

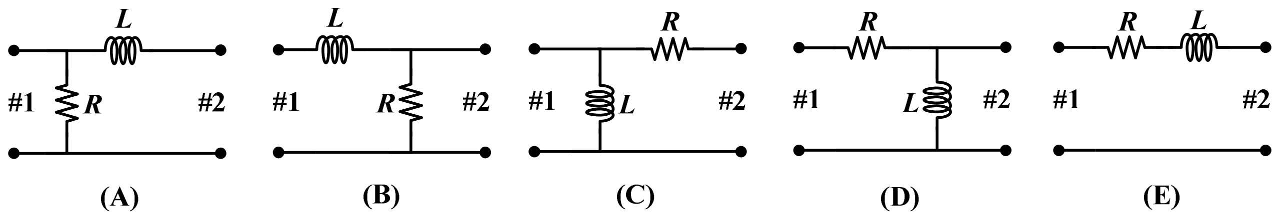


(4%)

9. A signal generator having Norton resistance R_{SG} is connected to Port #1 of a two-port network as shown below. At t = 0, the Norton current $i_{SG}(t)$ of the signal generator takes a step from zero to I_{SG}, and the current $i_O(t)$ is measured at Port #2 as shown below with the port short-circuited. Note that α is a unitless constant satisfying $0 < \alpha < 1$, and τ is a time constant. Assume that the Norton current of the signal generator is zero for a very long time prior to the step.



(a) Which of the following could be the two-port network? (8%)



(b) Determine the values of R and L in the network you chose in Part (a). And express the values in terms of I_{SG}, R_{SG}, α and τ. (8%)

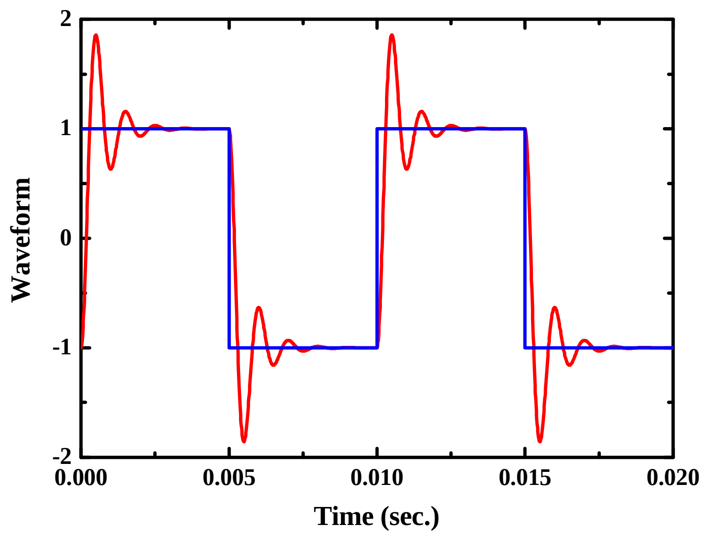
(a) Network (circle one):_________(A)_________(B)_________(C)_________(D)_________(E)_________(8%).
(b) R = ______________________________(4%), L = ______________________________(4%).

10. San Chang, a NTHU student working for Professor Ele., has just found a rather strange piece of circuitry in the trash just outside the office of Prof. Sistem. The circuit has three exposed terminals and it has exactly one resistor, one inductor, and one capacitor, but San cannot see how they are connected, because the connections are protected by epoxy. He can read the capacitor label: it says that the capacitor has a capacitance of 1μF **(*Observation O_1*)**. However, the other labels are not readable.

Being a naturally curious NTHU student, San takes the circuit to the lab to see what can be determined about this strange device by experiment. San labels the terminals with the letters "x", "y", and "z" with a marker pen. He then takes several measurements. First, San measures the resistances between the terminals of the mystery circuit with an Ohmmeter, and makes the following observations:

x − y: infinity **(*Observation O_2*)**
y − z: infinity **(*Observation O_3*)**
z − x: 80 Ω **(*Observation O_4*)**

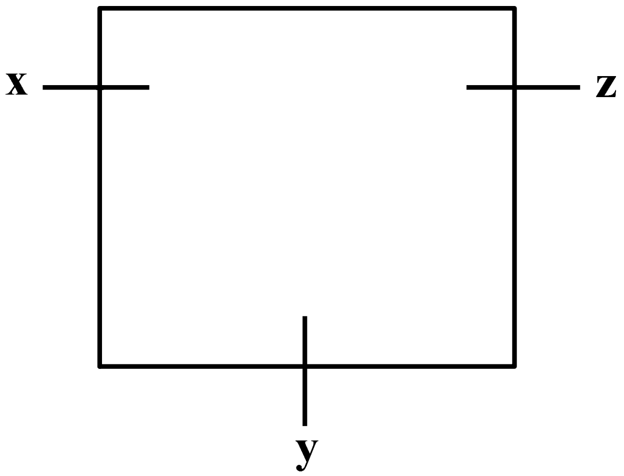
Next, San uses a signal generator, which may be modeled as a voltage source, to apply a 1 Volt, 100 Hz, square-wave signal from the x terminal to the y terminal. He uses his oscilloscope to display the voltage from z to y superimposed on the square wave, at the same scale as the square wave, as shown in the figure below **(*Observation O_5*)**. As you can see, He observes that the waveform from z to y follows the square wave, but there is ringing with a cycle period of about 1 ms.



(a) Draw the mysterious circuit from above *Observations*. Assume that the inductor and capacitor are ideal. Explain your choice. (6%)

(b) What is the inductance (approximately) of the inductor that is in the circuit? (6%)

(a)



(3%)

Reasons:____,

____,

____(3%),

(b) L = ____(6%).