Additional Practicing Problems

for

EE2008E Circuits

Prepared

by

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Q.1 In the circuit of Fig. 1, the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$.
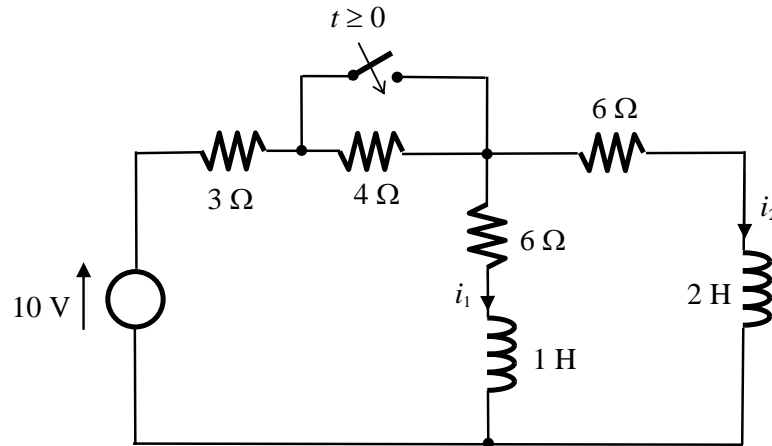

Fig. 1

(a) Determine the currents for both inductors for $t < 0$.

(5 marks)

(b) Determine the currents and voltages for both inductors just right after the switch is closed.

(5 marks)

(c) Derive (**DO NOT SOLVE**) the differential equation governing the circuit in terms of i_1. Compute the roots of its characteristic polynomial. Is the circuit over damped, under damped or critically damped?

(15 marks)

Q.2 Consider the circuit in Fig. 2 below. Assume that the 1 F capacitor is initially charged to − 1 V and the 2 F capacitor is initially charged to 1 V.
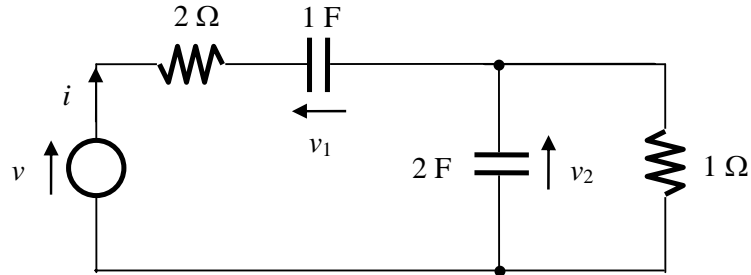

Fig. 2

(a) Derive the state and the output equations for the circuit with the input being the voltage source, v, and the output being the current drawn from the source, i.

(10 marks)

(b) Compute the transfer function of the circuit. Compute the poles and zeros of the transfer function.

(5 marks)

(c) Compute the zero input response and complete response of the circuit if $v = 1$ V.

(10 marks)

Q.1 Consider the circuit given in Fig. 1 below. Assume that the inductor and the capacitor are initially uncharged.
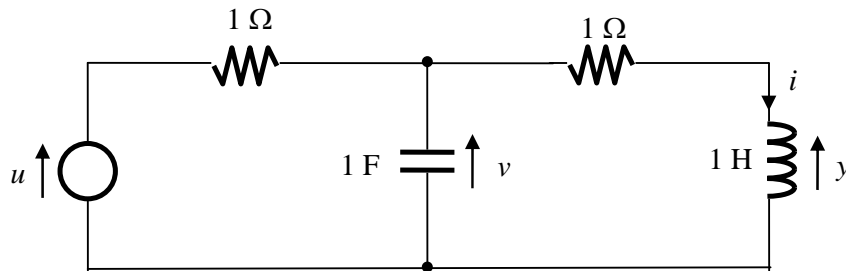

Fig. 1

(a) Derive the associated state and output equations with the input being the voltage source, u, and the output being the voltage across the inductor, y.

(10 marks)

(b) Compute the transfer function of the circuit. Compute its zeros and poles.

(5 marks)

(c) Compute the complete response of the circuit for $u = 1$V.

(10 marks)

Q.2 In the circuit of Fig. 2, the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$.
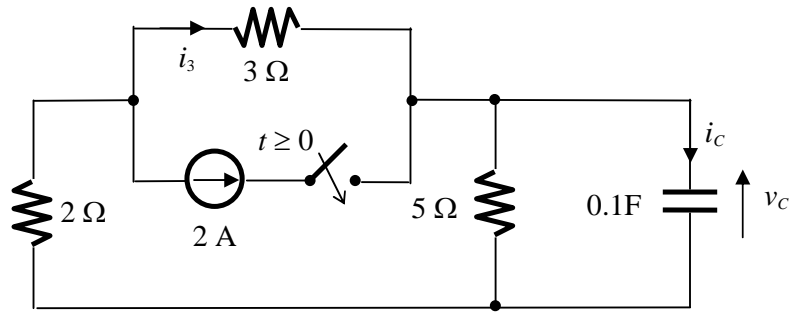

Fig. 2

(a) Determine i_3, i_C and v_C just before the switch is closed (i.e., $t = 0^-$).

(5 Marks)

(b) Determine i_3, i_C and v_C just after the switch is closed (i.e., $t = 0^+$).

(5 Marks)

(c) Determine i_3, i_C and v_C for $t = \infty$.

(5 Marks)

(d) Derive (but don't solve) the differential equation governing the circuit for $t \geq 0$.

(10 Marks)

Q.1 In the circuit of Fig. 1, the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$.
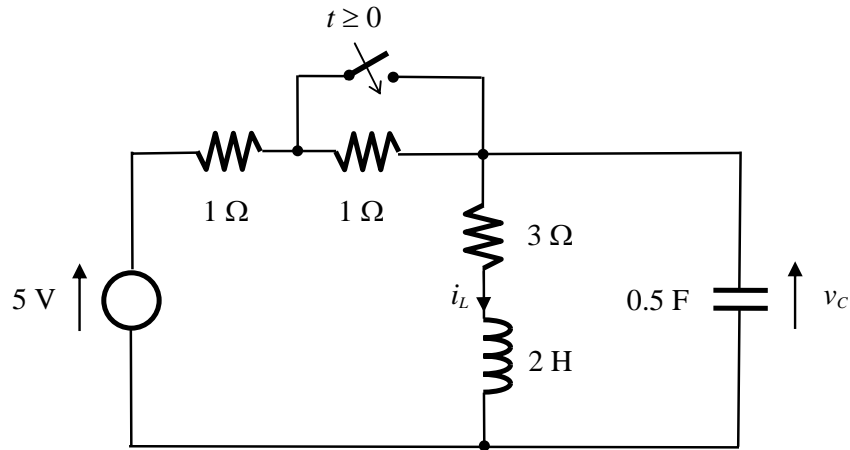

Fig. 1

(a) Determine the capacitor voltage and inductor current for $t < 0$.

(5 marks)

(b) Determine the capacitor current and inductor voltage just right after the switch is closed.

(5 marks)

(c) Derive the differential equation governing the circuit in terms of i_L. Compute the roots of its characteristic polynomial. Is the circuit over damped, under damped or critically damped?

(15 marks)

Q.2 Consider the circuit given in Fig. 2 below. Assume that the capacitor and the inductor are initially uncharged.
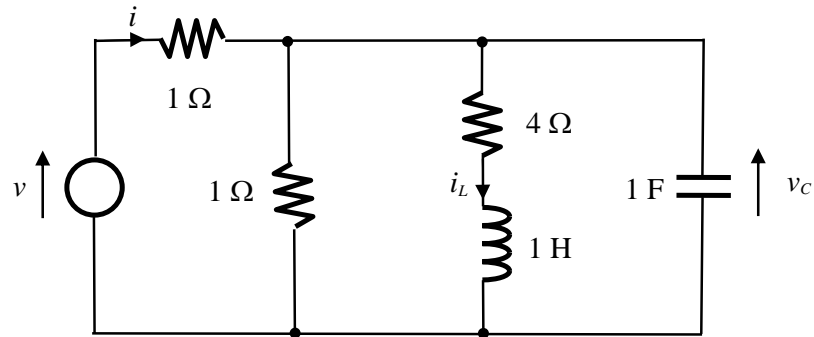

Fig. 2

(a) Derive the state and output equations for the circuit with the input being the voltage source, v, and the output being the current drawn from the source, i.

(10 marks)

(b) Compute the transfer function of the circuit. Compute the poles of the system.

(5 marks)

(c) Compute the zero response and the complete response of the circuit if $v = 9V$.

(10 marks)

Q.1 (a) In the circuit of Fig. 1(a), the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$.

(i) Determine the inductor current and voltage as well as the capacitor current and voltage just before and just after the switch has been moved to the final position.

(ii) Determine the steady state current of the voltage source and the steady state voltage of the current source for $t = \infty$.
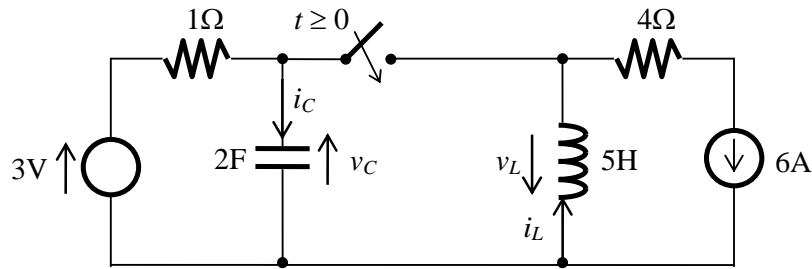

Fig. 1(a)

(12 Marks)

(b) In the circuit of Fig. 1(b), the switch has been in the position shown for a long time and is open for time $t \geq 0$. Determine the values of the capacitor voltage and the inductor current for all time t.
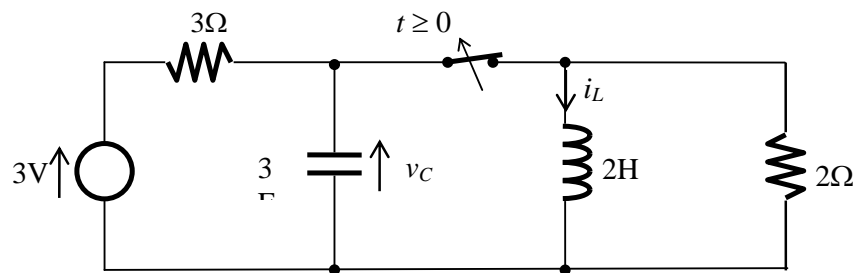

Fig. 1(b)

(13 Marks)

Q.2 Consider the circuit given in Fig. 2 below. Assume that the inductor is initially charged to 1A and the capacitor is initially discharged.
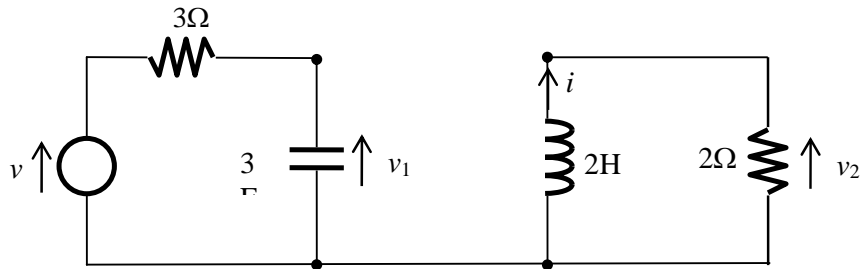

Fig. 2

(a) Derive the associated state and output equations with the input being the voltage source, v, and the output being v_1 and v_2.

(10 marks)

(b) Compute the transfer function of the circuit. Is the system stable? Why?

(5 marks)

(c) Compute the zero response and the complete response of the circuit if $v = 3V$.

(10 marks)

Q.1 (a) In the circuit of Fig. 1(a), the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$. Determine the inductor current and voltage as well as the capacitor current and voltage just before and just after the switch has been moved to the final position. Determine the steady state current of the voltage source and the steady state voltage of the current source.
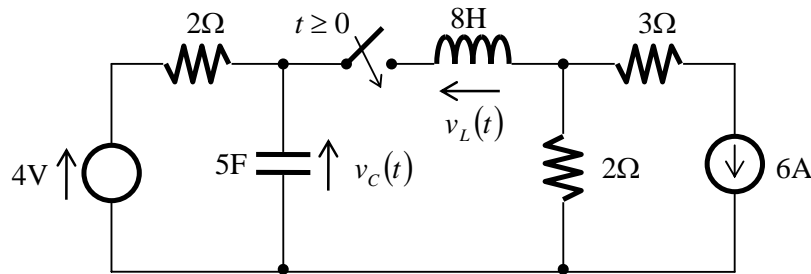

Fig. 1(a)

(14 Marks)

(b) Assuming the capacitor to be initially uncharged, derive (but need not solve) the differential equation from which the inductor current can be found in the circuit of Fig. 1(b). Determine the values of C for the circuit to be critically damped.
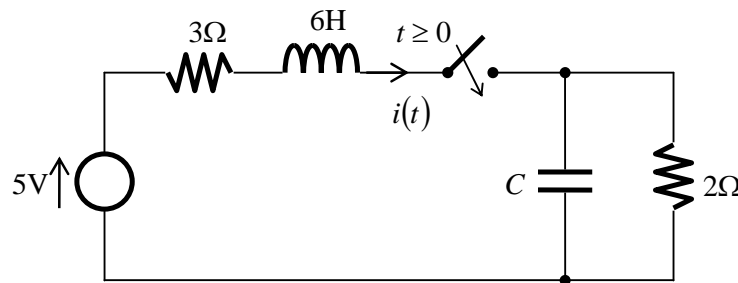

Fig. 1(b)

(11 Marks)

Q.2 Consider the circuit given in Fig. 2 below. Assume that the capacitor is initially charged to 1V and the inductor is initially uncharged.
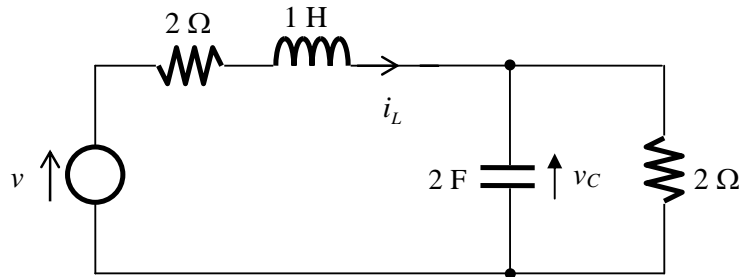

Fig. 2

(a) Derive the associated state and output equations with the input being the voltage source, v, and the output being the current, i_L.

(10 marks)

(b) Compute the transfer function of the circuit. What are the poles of the system? Is it stable? Why?

(5 marks)

(c) Compute the zero response and the complete response of the circuit if $v = 5V$.

(8 marks)

(d) Sketch the complete response obtained in Part (c) for up to 5 seconds.

(2 marks)

Q.1 (a) In the circuit of Fig. 1(a), the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$. Determine the following:

   (i)   the values of i, v and v_2 for the moment just before the switch is closed.
   (ii)   the values of i, v and v_2 for the moment just after the switch is closed.
   (iii)   the values of i, v, v_2 and the voltages across the current sources for $t = \infty$.
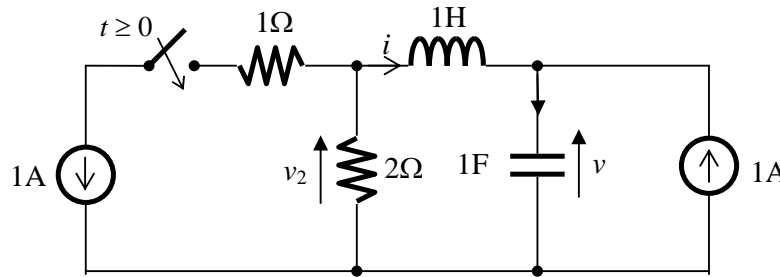

Fig. 1(a)

(12 marks)

(b) In the circuit of Fig. 1(b), assuming both the capacitor and inductor to be initially uncharged, derive (but do not solve) the differential equation governing the circuit after the switch is closed. Determine the values or range of C such that the circuit's characteristic polynomial has:

   (i) two real distinct real roots;
   (ii) two identical roots; and
   (iii) two complex roots.

For $C = 0.1875F$, find the dominating time constant (the largest one) of the circuit.
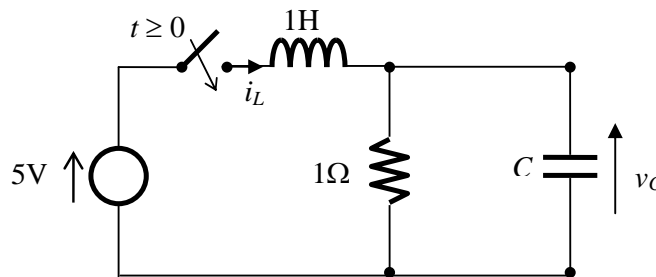

Fig. 1(b)

(13 marks)

Q.2 Consider the circuit given in Fig. 2 below. Assume that the capacitor is initially charged to 1V and the inductor is initially uncharged.
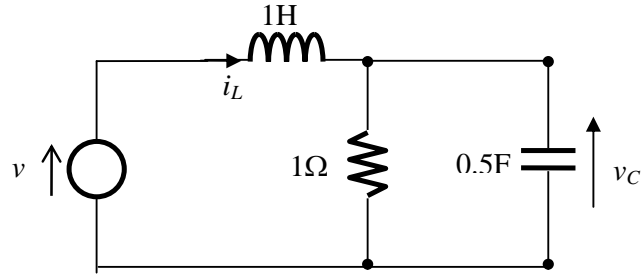

Fig. 2

(a) Derive the associated state and output equations with the input being the voltage source, v, and the output being the voltage, v_C.

(10 marks)

(b) Compute the transfer function of the circuit. What are the poles of the system? Is it stable? Why?

(5 marks)

(c) Compute the zero response and the complete response of the circuit if $v = 5V$.

(8 marks)

(d) Sketch the complete response obtained in Part (c) for up to 5 seconds.

(2 marks)

Q.1. In the circuit of Fig. 1, the switches have been in the positions shown for a long time and are thrown to the other position for $t \geq 0$.
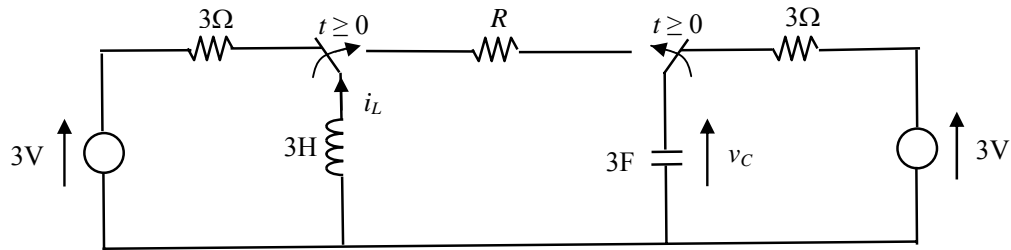

Fig. 1

(a) Determine the capacitor voltage and inductor current for $t < 0$.

(4 marks)

(b) Derive the governing differential equation in term of the capacitor voltage for $t \geq 0$.

(10 marks)

(c) Determine the value of R such that the circuit has a critically damped response.

(4 marks)

(d) For the value of R obtained in Part (c), determine the complete response of the inductor current for all time t.

(7 marks)

Q.2 Consider the circuits given in Fig. 2 below. Assume that both the capacitor and the inductor are initially discharged.
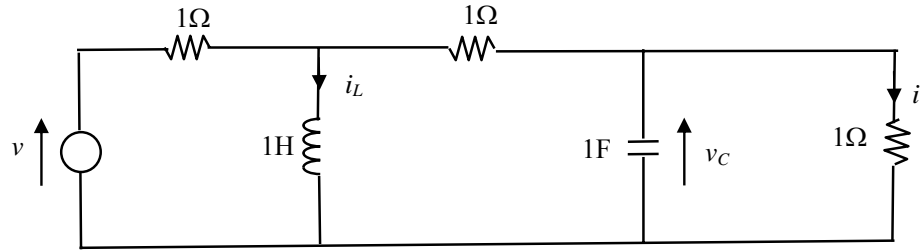

Fig. 2

(a) Derive the associated state and output equations with the input being the voltage source v and the output being the current i.

(10 marks)

(b) Compute the transfer function of the circuit. What are the poles of the system? Is it stable? Why?

(6 marks)

(c) Let $v = 1$ V. Compute the zero input response and complete response of the circuit.

(6 marks)

(d) Sketch the complete response obtained in Part (c).

(3 marks)

Q.1 (a) In the circuit of Fig. 1(a), the switch has been in the position shown for a long time and is thrown to the other position for time $t \geq 0$. Determine the values of the voltages and currents in the inductor and capacitor just before and just after the switch has been moved to the final position.
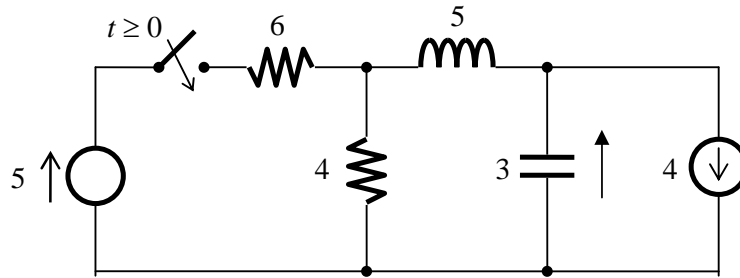

Fig. 1(a)

(12 marks)

(b) Assuming the capacitor to be initially uncharged, derive (but DO NOT solve) the differential equation from which the inductor current can be found in the circuit of Fig. 1(b). For what range of values of C will the circuit be underdamped? If C is such that the circuit is critically damped, will a change in the source voltage make it underdamped?
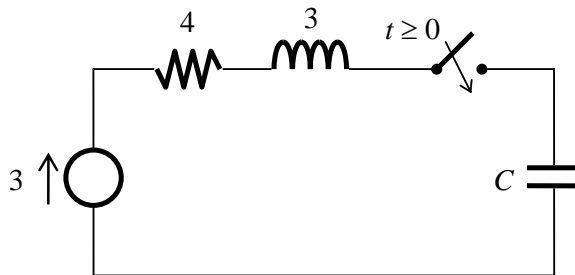

Fig. 1(b)

(13 marks)

Q.2 Consider the circuits given in Fig. 2 below. Assume that both the capacitor and the inductor are initially discharged.
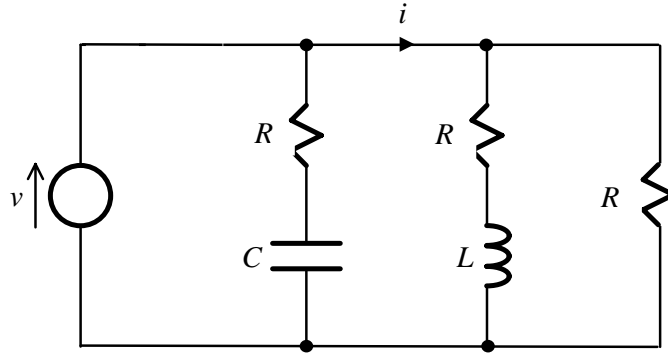

Fig. 2

(a) Derive the associated state and output equations with the input being the voltage source v and the output being the current i.

(13 marks)

(b) Compute the transfer function of the circuit. What are the poles of the system? Is it stable? Why?

(6 marks)

(c) Compute the zero response and the complete response of the circuit if $v = 1$ volt.

(6 marks)