

# ECE 2260 Midterm 1

*Week of: February 12, 2019*

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You have 120 minutes for 5 problems. Taking additional time beyond the allotted time will result in point deductions.

- Show enough (neat) work in the clear spaces on this exam to convince us that you derived, not guessed, your answers.
- Put your final answers in the boxes at the bottom of the page.

You can use two pages of notes and a calculator.

Problem	Score	Possible Points
1		20
2		20
3		20
4		20
5		20
<b>Total score</b>		100

**1 Short answer**

- (a) A number of 2<sup>nd</sup> order systems are described by the following characteristic equations. Determine if the system is over-damped, under-damped, or critically damped. Circle one for each case.

(i)  $s^2 + 4s + 4 = 0$

over-damped

under-damped

critically damped

(ii)  $s^2 + 4s + 13 = 0$

over-damped

under-damped

critically damped

- (b) A parallel, natural response RLC circuit is in its simplest form (a resistor  $R$ , an inductor  $L$ , and capacitor  $C$  all in parallel). Given the following component values, determine if the response is over-damped, under-damped, or critically damped.

- (i)  $R = 400\ \Omega$ ,  $L = 25\ \text{mH}$ , and  $C = 25\ \text{nF}$

over-damped

under-damped

critically damped

- (ii)  $R = 625\ \Omega$ ,  $L = 25\ \text{mH}$ , and  $C = 25\ \text{nF}$

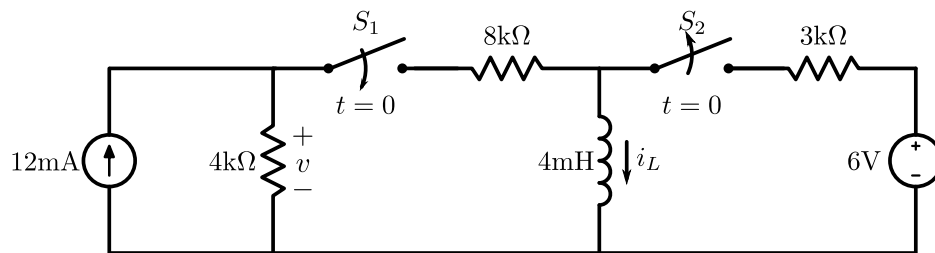
over-damped

under-damped

critically damped

## 2 RL step response circuit

For the following circuit,  $S_1$  closes and  $S_2$  opens simultaneously at time  $t = 0$  s. Determine  $i_L(t)$  after the switches open/close.



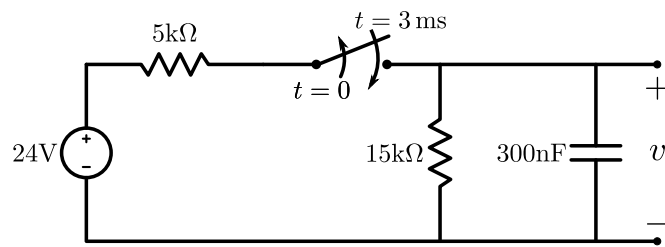
$$i_L(t) =$$

Now find  $v(t)$  after the switches open/close.

$v(t) =$

### 3 Sequential switching

The switch in the following circuit has been closed for a long time and is opened at  $t = 0$ . The switch is reclosed at  $t = 3 \text{ ms}$ . Find  $v(t)$  for  $t \geq 0$ . (Please write your answer in a piece-wise fashion.)

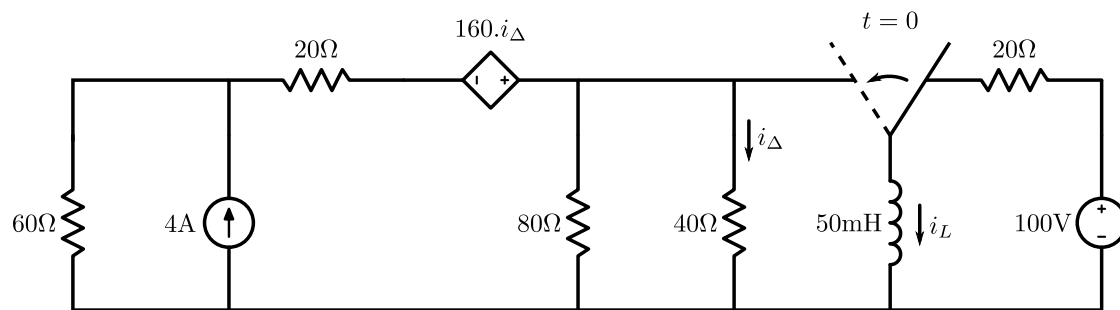


Your work, continued...

$$v(t) =$$

#### 4 RL step response with dependent source

In the circuit below, the switch toggles at time  $t = 0$ . Find  $i_L$ , the current through the inductor, for  $t \geq 0$ .



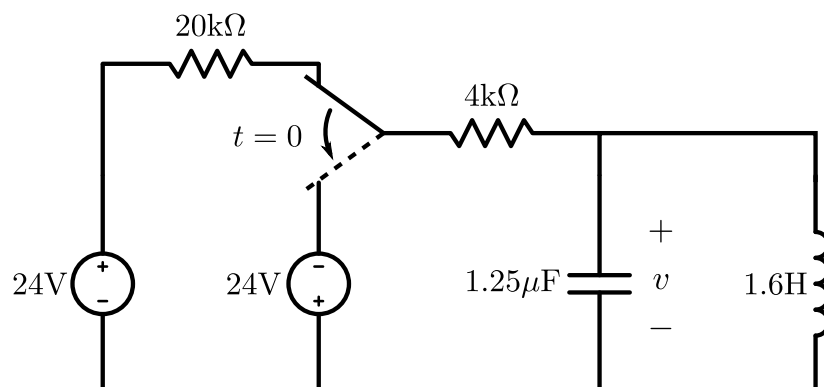


Your work, continued...

$$i_L(t) =$$

**5 RLC circuits**

For the following circuit, find  $v(t)$  for  $t \geq 0$ .



Your work, continued...

$v(t) =$