

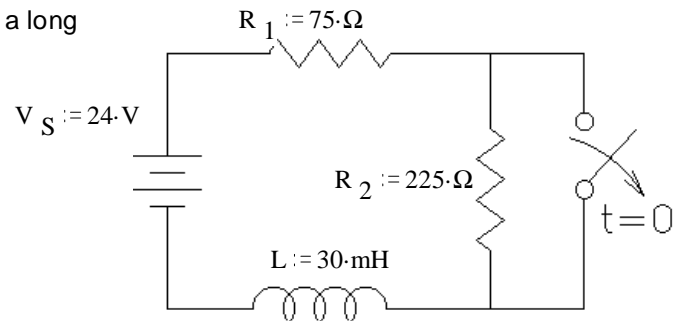
ECE2210 Final given: Fall 08

1. (22 pts) The switch has been closed (making contact) for a long time and is switched open (as shown) at time $t = 0$.

a) Find the complete expression for $i_L(t)$.

b) What is i_L when $t = \tau$? $i_L(\tau) = ?$

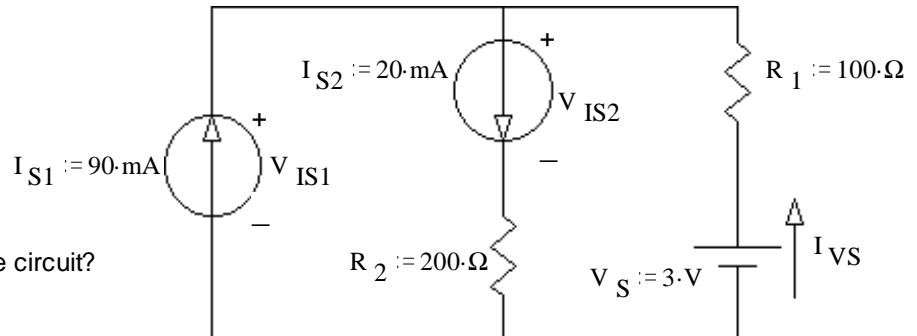
c) At time $t = \tau$ the switch is closed again. Find the complete expression for $i_L(t')$, where t' starts at $t = \tau$. Be sure to clearly show the time constant.



2. (18 pts)

a) Find: V_1 , V_2 & I_3

b) V_S Supplies how much power to the circuit?

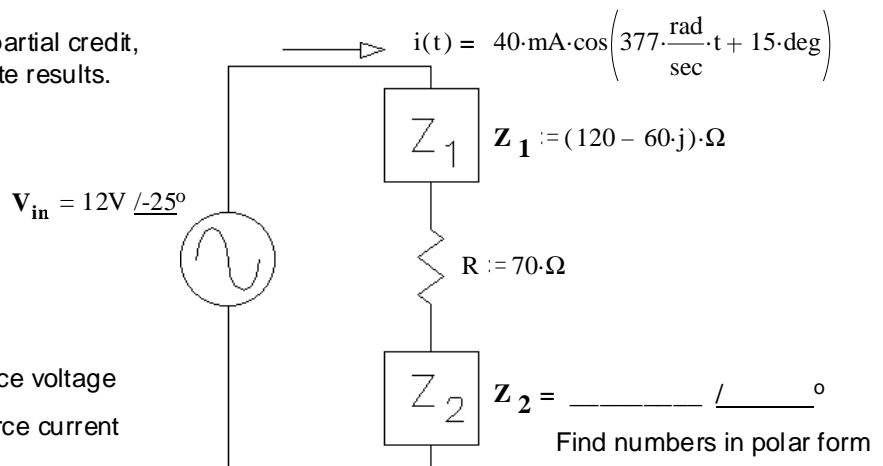


3. (17 pts)

a) Find Z_2 in polar numeric form. For partial credit, you must show work and/or intermediate results.

b) Circle 1:

- The source current leads the source voltage
- The source voltage leads the source current



4. (18 pts) a) Find the s-type transfer function of the circuit shown.

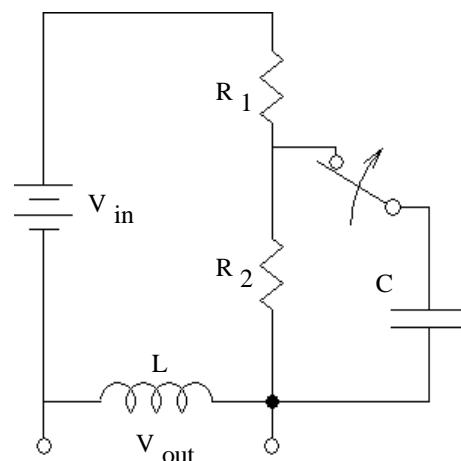
You MUST show work to get credit. Simplify your expression for $H(s)$ so that the denominator is a simple polynomial.

The "output" is the voltage across the inductor. $H(s) = ?$

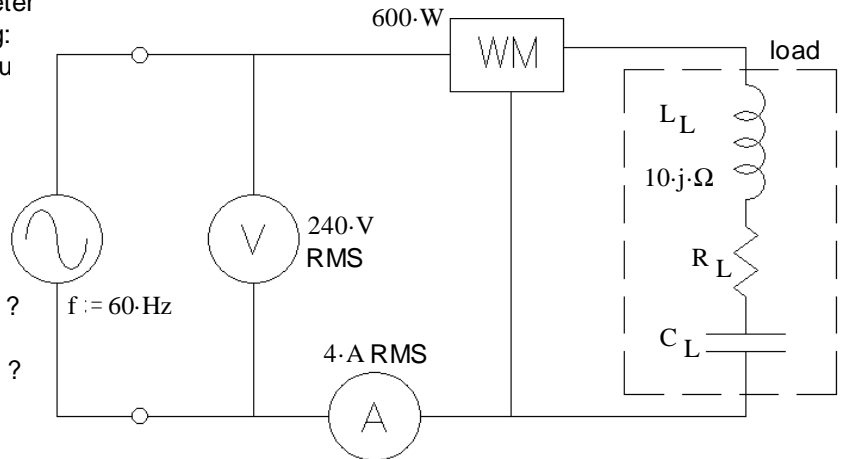
b) Find the characteristic equation of the circuit shown. $= ?$

c) The solutions to the characteristic equation are called the _____ of the transfer function.

d) Does the transfer function have any zeroes? If yes, express them in terms of the circuit parts.



5. (29 pts) R, & C together are the load in the circuit shown. The voltmeter, ammeter, and wattmeter measurements are shown. Find the following: Be sure to show the correct units for each value



- The real power. $P = ?$
- The value of the load resistor. $R_L = ?$
- The apparent power. $|S| = ?$
- The magnitude of the reactive power. $|Q| = ?$
- The impedance of the capacitor. $Z_{CL} = ?$
- The complex power. $S = ?$
- The power factor. $pf = ?$
- The power factor is: i) leading ii) lagging (circle one)
- The two components of the load are in a box which cannot be opened. Add (draw it) another component to the circuit above which can correct the power factor (make $pf = 1$). Show the correct component in the correct place and find its value. This component should not affect the real power consumption of the load.

6. See last page

Use constant-voltage-drop models for the diodes and LEDs

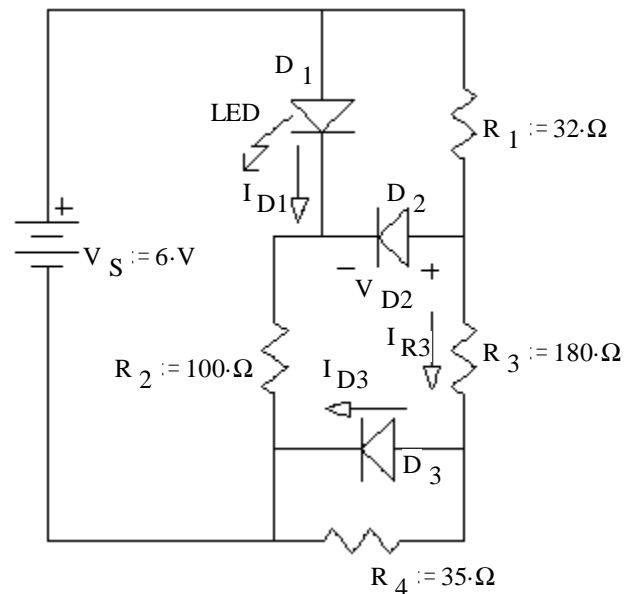
7. (25 pts) Assume that diodes D_1 and D_3 **DO** conduct.

Assume that diode D_2 does **NOT** conduct.

- a) Find I_{D1} , I_{R3} , I_{D3} , & V_{D2} based on these assumptions. Stick with these assumptions even if your answers come out absurd.

$$I_{D1} = \underline{\hspace{2cm}} \quad I_{D3} = \underline{\hspace{2cm}}$$

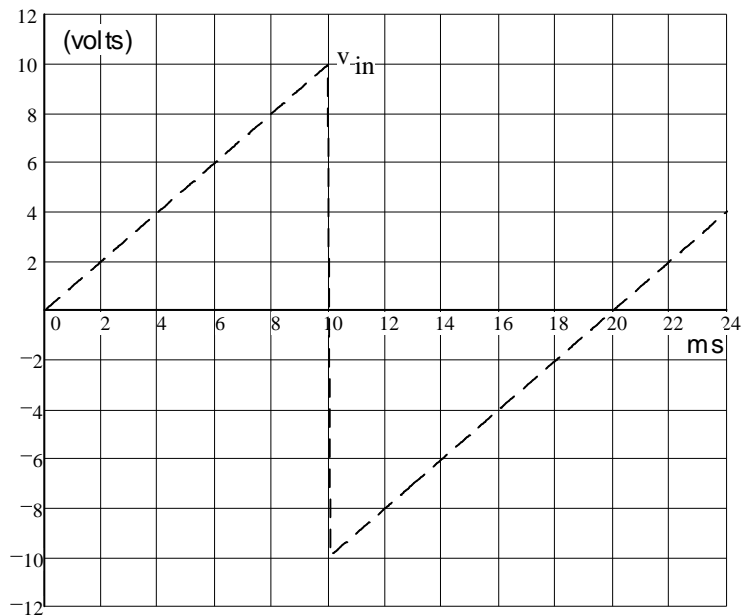
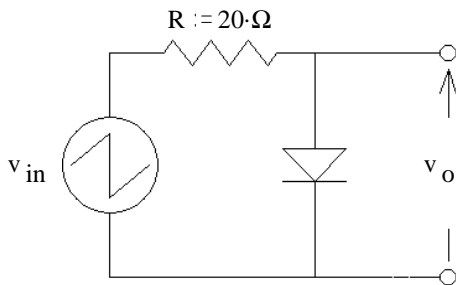
$$I_{R3} = \underline{\hspace{2cm}} \quad V_{D2} = \underline{\hspace{2cm}}$$



- Based on the numbers above, was the assumption about D_1 correct? yes no (circle one)
How do you know? (Specifically show a value which is or is not within a correct range.)
- Was the assumption about D_2 correct? yes no (circle one)
How do you know? (Specifically show a value which is or is not within a correct range.)
- Was the assumption about D_3 correct? yes no (circle one)
How do you know? (Specifically show a value which is or is not within a correct range.)
- Based on your answers to parts b), c) & e), Circle one:
 - The **real** $I_{R3} < I_{R3}$ calculated in part a.
 - The **real** $I_{R3} = I_{R3}$ calculated in part a.
 - The **real** $I_{R3} > I_{R3}$ calculated in part a.

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8. (10 pts) A voltage waveform (dotted line) is applied to the circuit shown. Accurately draw the output waveform (v_o) you expect to see. Label important times and voltage levels.



9. (24 pts) A transistor is used to control the current flow through an inductive load (in the dotted box, it could be a relay coil or a DC motor).

- a) $\beta := 30$ Assume the switch has been open for a long time and the transistor is in the active region, find I_2 , and V_{EC} and P_Q .

$$I_L = ?$$

$$V_{EC} = ?$$

$$P_Q = ?$$

- b) Was the transistor actually operating in the active region? yes no circle one

How do you know? (Specifically show a value which is or is not within a correct range.)

- c) What minimum β would be required to achieve saturation?

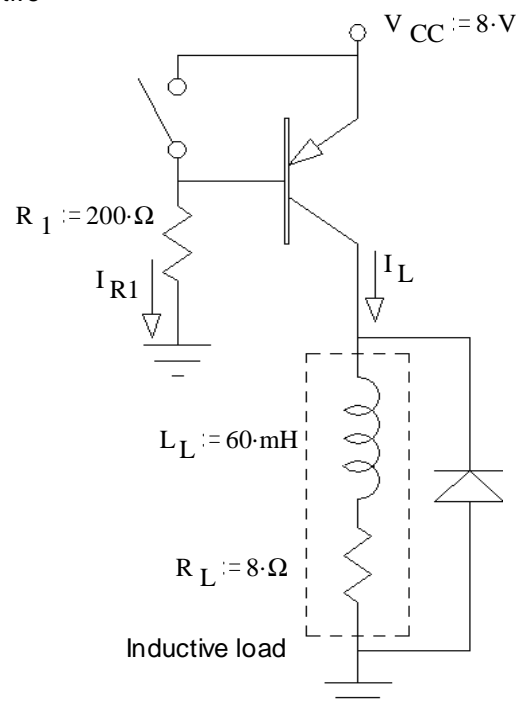
- d) You can't change the β . Find the maximum value of R_1 , so that the transistor will be in saturation.

- e) The diode in this circuit conducts a significant current:

- | | |
|---------------------------------|-----------------------------------|
| A) never. | D) when the switch closes. |
| B) when the switch opens. | E) whenever the switch is closed. |
| C) whenever the switch is open. | F) always. |

- f) R_1 , is that found in part d). The switch is opened and closed a few times.

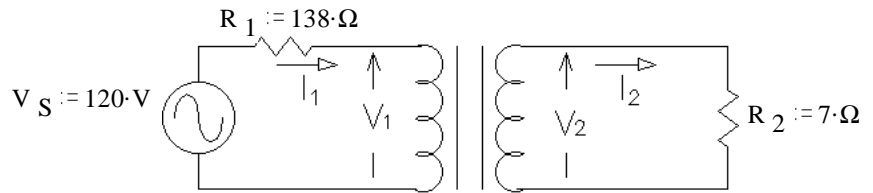
What is the maximum diode current you expect.
(Answer 0 if it never conducts.)



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6. (17 pts) The transformer shown in the circuit below is ideal. It is rated at 220/55 V, 100 VA, 60 Hz
Find the following:

a) $I_1 = ?$ b) $V_2 = ?$ c) $I_2 = ?$



- d) Is this transformer operating within its ratings?
Show your evidence.

10. Do you want your grade and scores posted on my door and on the Internet? Yes No (Circle one)

If your answer is yes, then provide some sort of alias or password: _____

The grades will be posted on my door in alphabetical order under the alias that you provide here. I will not post grades under your real name. The Internet version will be a pdf file which you can download. Both will show the homework, lab, and exam scores of everyone who answers yes here.

Answers

1. a) $80 \cdot \text{mA} + 240 \cdot \text{mA} \cdot e^{-\frac{t}{0.1 \cdot \text{ms}}}$ b) $168.3 \cdot \text{mA}$ c) $320 \cdot \text{mA} - 151.7 \cdot \text{mA} \cdot e^{-\frac{t'}{0.4 \cdot \text{ms}}}$
2. a) $10 \cdot \text{V}$ $6 \cdot \text{V}$ -70mA b) $-210 \cdot \text{mW}$ (negative because it absorbs power from the circuit)
3. a) $Z_2 = 138.7 \Omega \angle -73.3^\circ$ b) i)
4. a) $\frac{s \cdot \left(s + \frac{1}{R_2 \cdot C} \right)}{s^2 + \left(\frac{R_1}{L} + \frac{1}{C \cdot R_2} \right) \cdot s + \left(\frac{R_1}{R_2} + 1 \right) \cdot \frac{1}{L \cdot C}}$ b) $0 = s^2 + \left(\frac{R_1}{L} + \frac{1}{C \cdot R_2} \right) \cdot s + \left(\frac{R_1}{R_2} + 1 \right) \cdot \frac{1}{L \cdot C}$ c) poles
d) 0 and $-\frac{1}{R_2 \cdot C}$
5. a) $600 \cdot \text{W}$ b) $37.5 \cdot \Omega$ c) $960 \cdot \text{VA}$ d) $749 \cdot \text{VAR}$ e) $-56.84 \cdot \text{j} \cdot \Omega$ f) $(600 - 749 \cdot \text{j}) \cdot \text{VA}$ g) 0.625
h) lagging i) Add a 204-mH inductor in parallel with load
6. a) $480 \cdot \text{mA}$ b) $13.44 \cdot \text{V}$ c) $1.92 \cdot \text{A}$ d) no
7. a) $40 \cdot \text{mA}$ $25 \cdot \text{mA}$ $5 \cdot \text{mA}$ $1.2 \cdot \text{V}$
b) yes $I_{D1} = 40 \cdot \text{mA} > 0$
c) no $V_{D2} = 1.2 \cdot \text{V} > 0.7 \text{V}$
d) yes $I_{D3} = 5 \cdot \text{mA} > 0$
e) i)
8. a) 1100 mA -0.76 V -0.83 W
b) no $V_{CE} = -0.76 \cdot \text{V} < 0.2 \cdot \text{V}$
c) 26.7 d) $224.6 \cdot \Omega$ e) D f) 975 mA

