ECE 2100 Circuit Analysis
Fall 2019
Exam #2

NAME: ____

INSTRUCTIONS:

1. **THIS EXAM IS CLOSED BOOK AND CLOSED NOTES**.
   A "Potentially Useful Facts" sheet is provided.
2. **NO ELECTRONIC DEVICES ARE ALLOWED**.
   All electronic devices, *including watches*, must be stowed away.
3. You may only use the provided pencil.
   All other writing instruments and erasers must be stowed away.
4. No hats or hoods may be worn during the exam.
5. Work each problem in the provided space.
6. **Show ALL work** required to arrive at a solution for either full or partial credit.
7. READ the entire question before answering.
8. Have your student ID on your desktop for inspection by the instructor.
9. SIGN the honesty pledge at the bottom of the page. Exams without a signature will receive no credit.

I have neither given nor received assistance from anyone in regards to completion of this exam. I have followed the instructions as provided on this sheet. I HAVE VERIFIED THAT THIS EXAM HAS (8) PAGES.

SIGNATURE: ___________________________ DATE: __________

Note: Schematics prepared using LTspice (linear.com).

Potentially Useful Facts (updated 6 January 2017)

1. $$A\angle\theta = Ae^{j\theta} = A\cos\theta + A\sin\theta\, j$$

2. $$v = L\frac{di}{dt} \text{ (follows passive sign convention)}$$

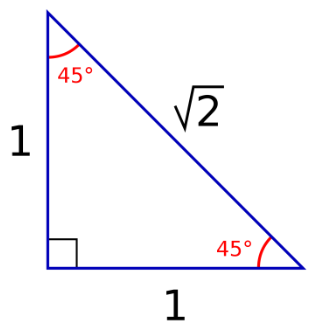
3. $$i = C\frac{dv}{dt} \text{ (follows passive sign convention)}$$

4. $$\overrightarrow{\boldsymbol{Z_L}} = j\omega L$$

5. $$\overrightarrow{\boldsymbol{Z_C}} = \frac{1}{j\omega C}$$

6. $$\vec{\boldsymbol{S}} = \overrightarrow{\boldsymbol{V}_{\mathbf{RMS}}}\left(\overrightarrow{\boldsymbol{I}_{\mathbf{RMS}}}\right)^* \text{ (follows passive sign convention)}$$

7. $$V_{\text{RMS}} = \sqrt{\frac{1}{T}\int_0^T v^2(t)dt}$$

8. 

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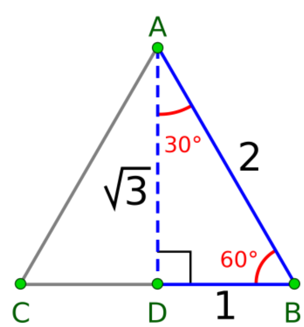
9. 

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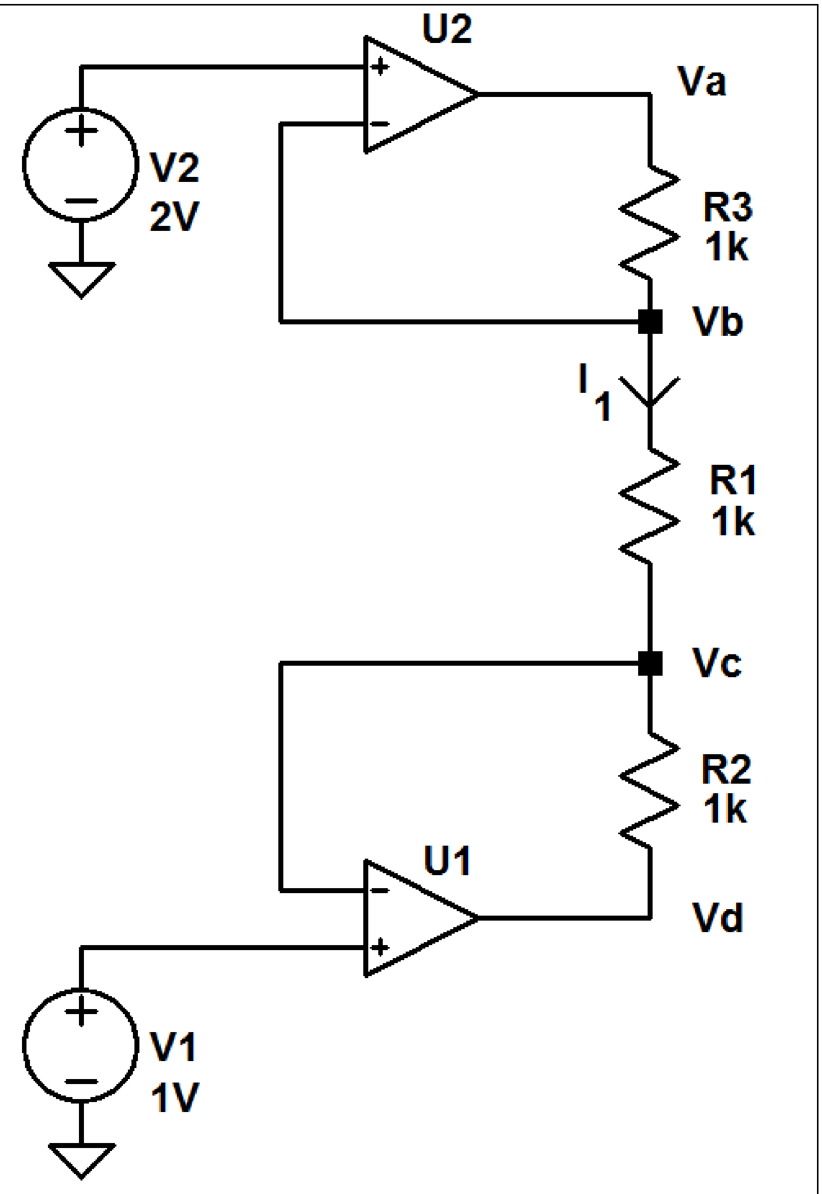
10. first-order DC circuit (natural and forced) response
$$x(t) = x(\infty) + [x(0) - x(\infty)]e^{-t/\tau}$$

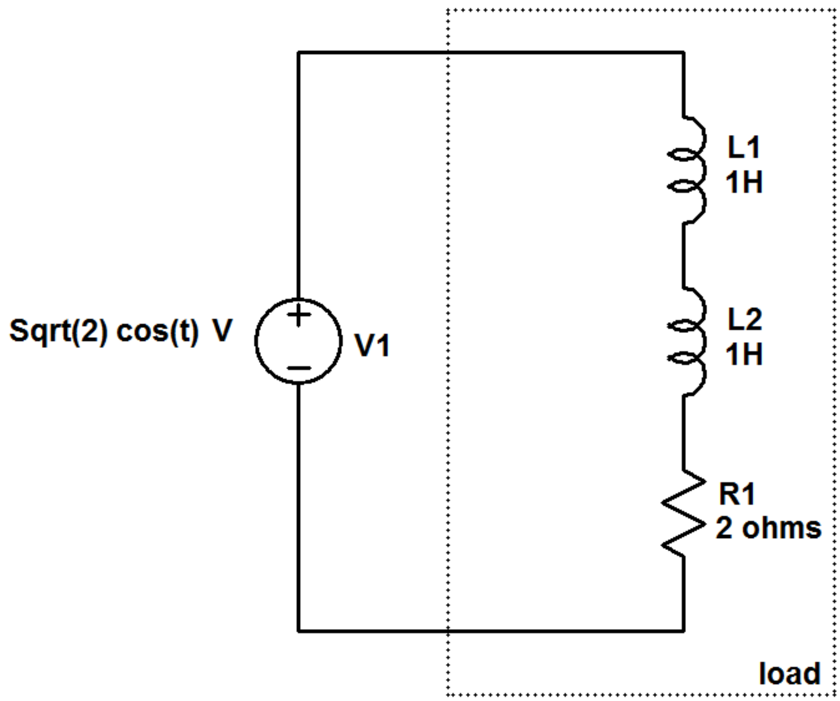
Maximum exam score is 32 points.

1. (5 points) The op-amps are ideal. Find the following quantities.
   Put answers in table.

Node voltage Vb	
Node voltage Vc	
Current I_1	
Node voltage Va	
Node voltage Vd	
quantity	**ans.**



2. (5 points) Consider the following circuit.
   Find the complex power of the load (consisting of L1, L2, and R1).



THERE ARE TWO PROBLEMS ON THIS PAGE

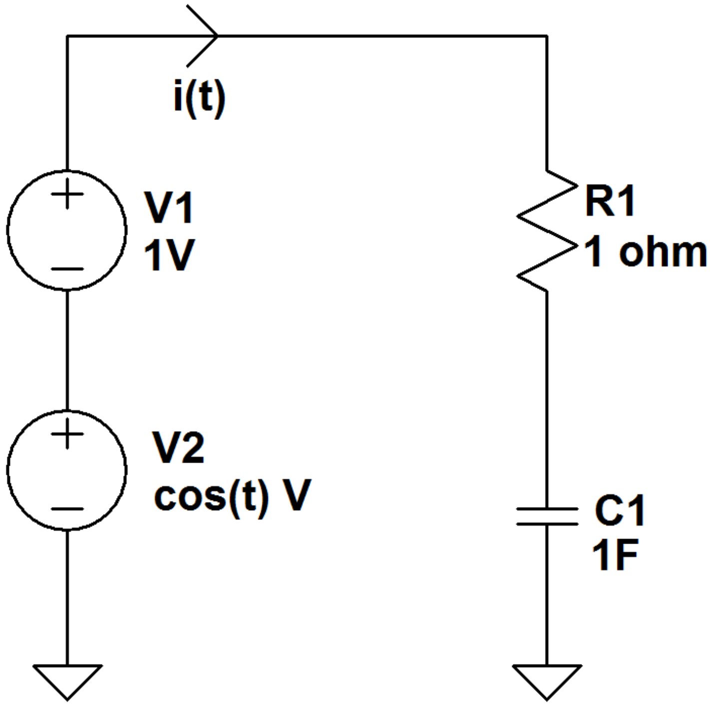
3. (5 points) The complex power of a load is $\vec{\boldsymbol{S}}$=1 - 10j VA. If the load voltage is 1V RMS and the frequency is 1 rad/s, find the value of a component to put in parallel with the load so that the new load has a unity power factor.
Your work must be clear – as always, watch units!

4. (2 points) Consider the system

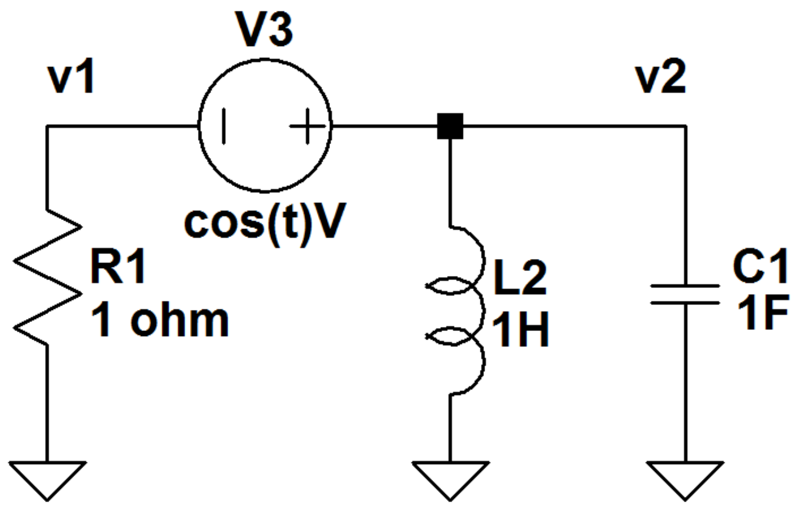
$$y = \mathrm{T}[x] = m\,x$$

where x is the system input and y is the system output.
Find a non-zero finite value of m so that this system is linear.
Justify your response. No partial credit.

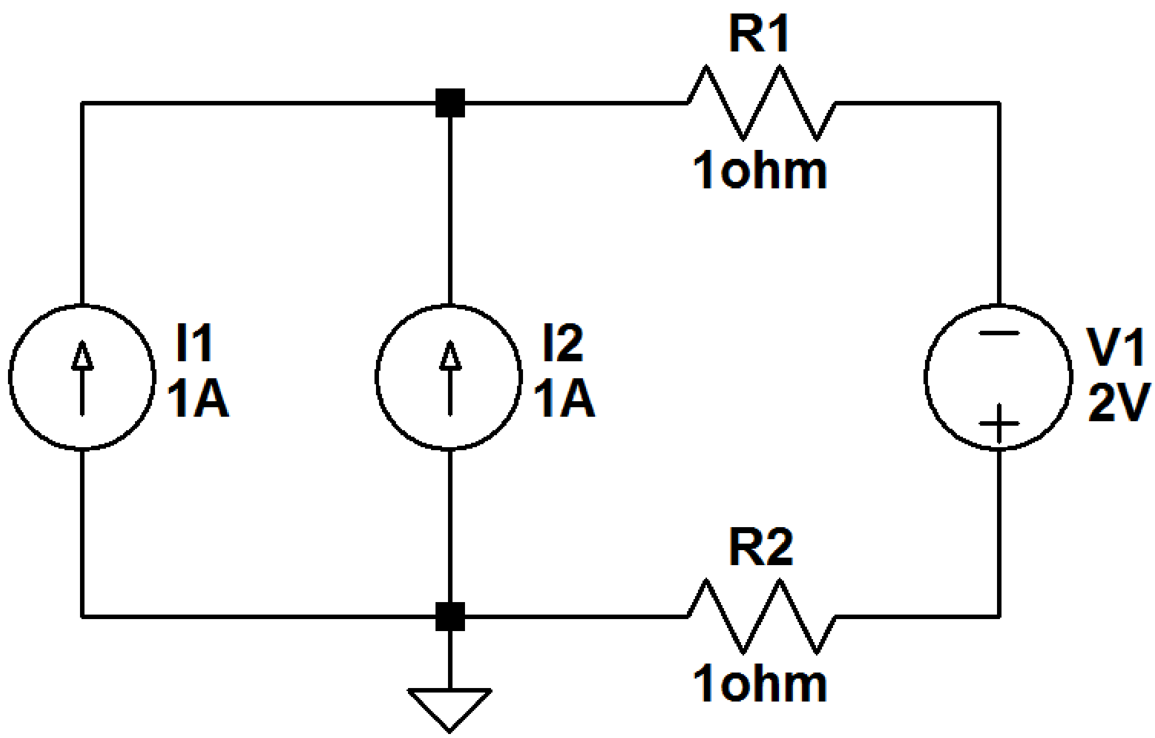
5. (5 points) Find current i(t) in the sinusoidal steady state using the **superposition principle**.



6. (5 points) Find node voltages v1(t) and v2(t) in the sinusoidal steady state using **nodal analysis**.



7. (5 points) Find the power of each circuit element.
You **must** show the voltage across (with polarity) and current through (with direction) each element. Put answers in table.



ELEMENT	POWER
I1	
I2	
R1	
R2	
V1	