ECE 2100 Circuit Analysis
Spring 2019
Final Exam

NAME: _____

INSTRUCTIONS:

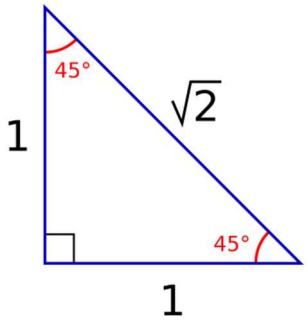
1. **THIS EXAM IS CLOSED BOOK AND CLOSED NOTES**.
   A "Potentially Useful Facts" sheet is provided.
2. **NO ELECTRONIC DEVICES ARE ALLOWED**.
   All electronic devices, *including watches*, must be stowed away.
3. You may only use the provided pencil.
   All other writing instruments and erasers must 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 (7) 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. $v = L\frac{di}{dt}$ (follows passive sign convention)
3. $i = C\frac{dv}{dt}$ (follows passive sign convention)
4. $\overrightarrow{\boldsymbol{Z_L}} = j\omega L$
5. $\overrightarrow{\boldsymbol{Z_C}} = \frac{1}{j\omega C}$
6. $\vec{\boldsymbol{S}} = \overrightarrow{\boldsymbol{V_{RMS}}}\ \left(\overrightarrow{\boldsymbol{I_{RMS}}}\right)^*$ (follows passive sign convention)
7. $V_{\text{RMS}=}\sqrt{\frac{1}{T}\int_0^T v^2(t)dt}$
8. 

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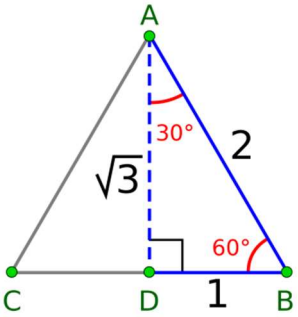
9. 

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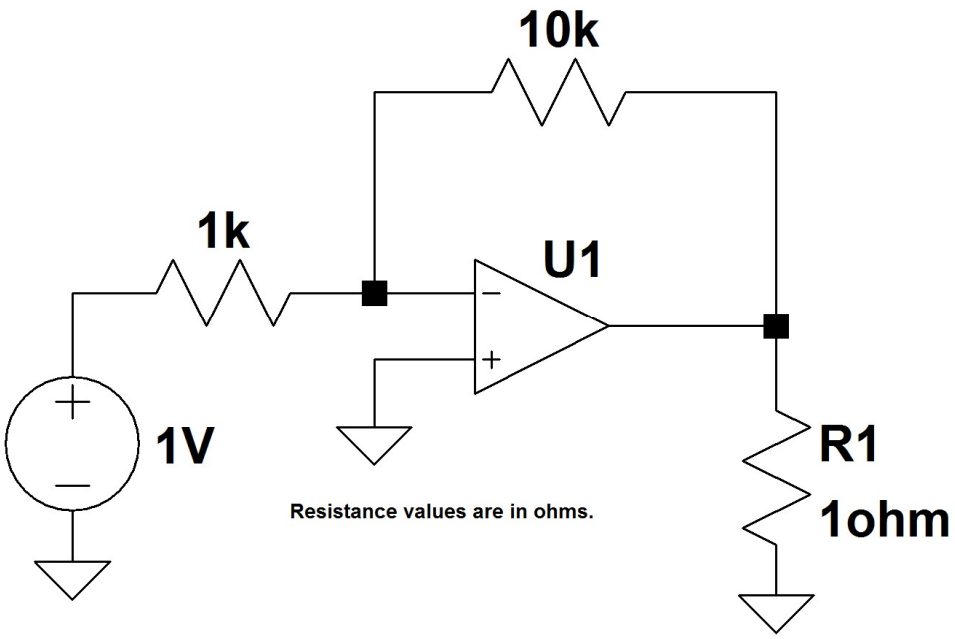
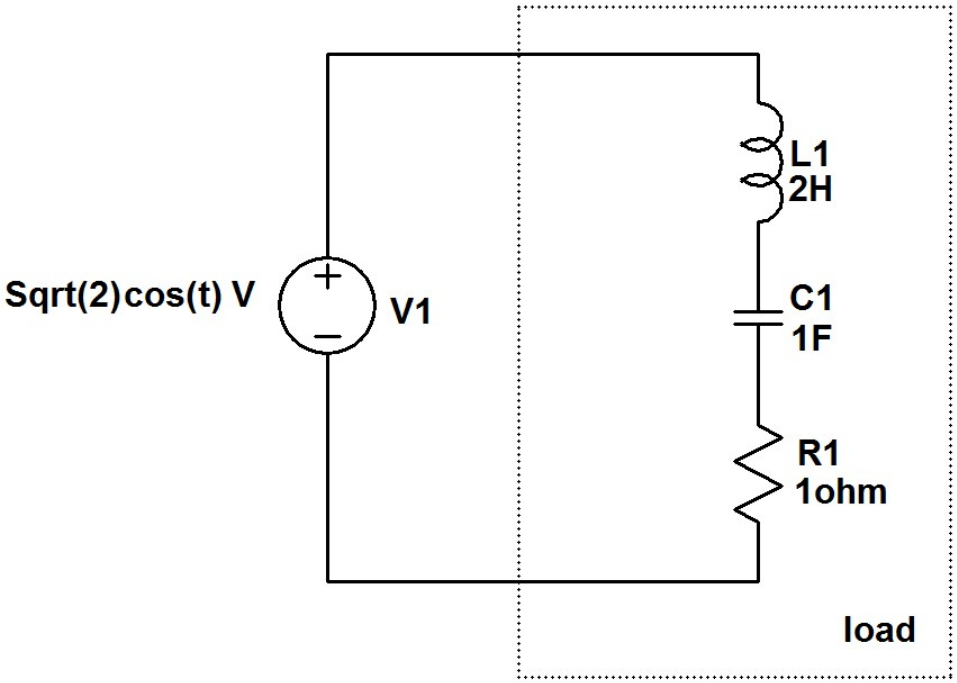
https://commons.wikimedia.org/wiki/File:30-60-90.svg
10. first-order DC circuit (natural and forced) response
$x(t) = x(\infty) + [x(0) - x(\infty)]e^{-t/\tau}$

Maximum exam score is 27 points.

1. The op-amp is ideal.
   Find the power of R1.
   You must show voltage polarities and current directions.



2. (5 points) Consider the following circuit.
   Find the complex power of the load (consisting of L1, C1, and R1*)*.
   You must show voltage polarities and current directions.



THERE ARE TWO PROBLEMS ON THIS PAGE

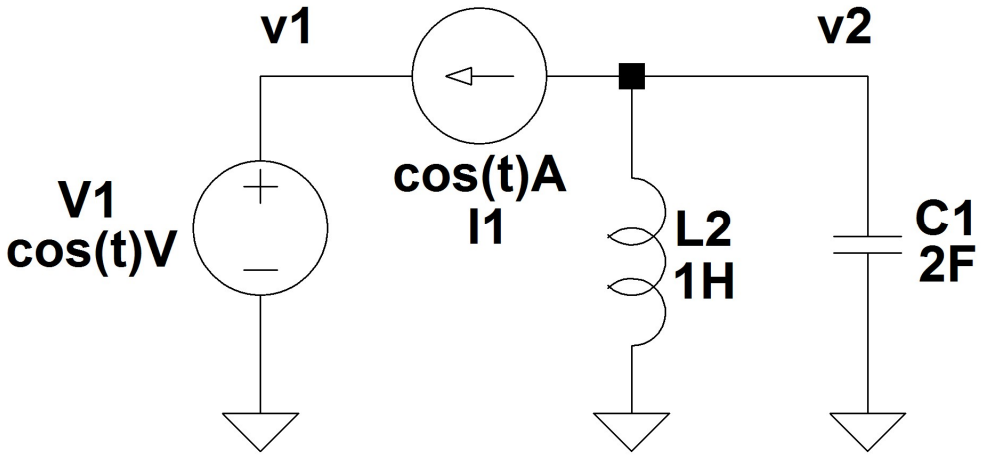
3. (5 points) The complex power of a load is $\vec{S}$=1 + 2j VA. If the load voltage is 1V RMS and the frequency is 1 rad/s, find the value of a component to put in parallel with the load so that the new load has a unity power factor.
   Your work must be clear – as always, watch units!

4. (2 points) Consider the system

$$y = \mathrm{T}[x] = 2x + b$$

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

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



6. (5 points) The switch is **OPENED** at t=0 after being closed for a long time. Find the current i(t) for t≥0.