E84 Spring '07: Midterm 2

You have 50 minutes to complete this closed book exam. You are not allowed to collaborate with anyone or use any other resources except for your single 8.5"x11" equation sheet. Your equation sheet should not have any solved circuits on it. You are allowed to use a calculator to perform arithmetic and basic math functions (cos, sin, arctan, square and sqrt should be all you need). The calculator should not be used to solve algebraic expressions or store formulas.

You will get the most credit for showing that you understand the concepts involved in the problem. This does not mean simply listing everything that you know about a particular type of device or relaying things that could be copied from an equation sheet – instead, I'm looking for careful analysis of the problem at hand. If there is a stumbling block between you and a final answer, explain what that stumbling block is, make an assumption and move on. Obviously, the scale of the assumption and its impact on the solution will determine how much partial credit is possible.

With the obvious time-constraints on this test, your best strategy is to attack each problem for a set period of time – allowing you enough time to attempt all four problems. I've provided time estimates to help you decide how much time to spend on each problem. I'd recommend not exceeding the suggested times until you've tried every problem, even if you don't have time to finish some problems. The time estimates add to 45 minutes, leaving you five extra minutes to use as you wish. This test is long and I don't necessarily expect you to finish. I want to test your knowledge on a variety of topics – so you should do your best to show me what you know about all four problems.

There are no purposeful ambiguities on this test. If you have any questions, ask.

Please show all work. State any assumptions where relevant. Show all units in your final answers. Make it clear where your final answer is. Unless specified, just give the forced response when asked. Always include proper units on your answers!

Good luck!

Name:_____

Problem 1: _____/ 25 (10 minutes)

Problem 2: _____/ 25 (10 minutes)

Problem 3: _____/ 25 (15 minutes)

Problem 4: _____/ 25 (10 minutes)

Total: _____/ 100

Problem 1 (25 points)

1a) (10 points) Z_1 and Z_2 are represented as phasors as shown in the phasor diagram above. Find the voltage across Z_2, $v_2(t)$.

$v_2(t)$=_____

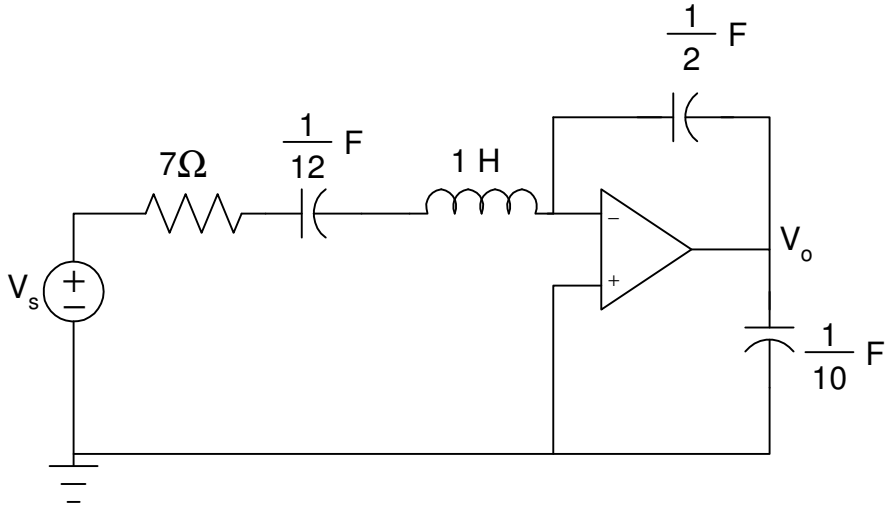
1b) (10 points) Find the average real power, P, and the average reactive power, Q, absorbed by Z_2.

P=_____ **Q=**_____

1c) (5 points) What impedance, Z_3, could be added in series to Z_1 and Z_2 to maximize the power delivered by the source?

Z_3=_____

Problem 2 (25 points)



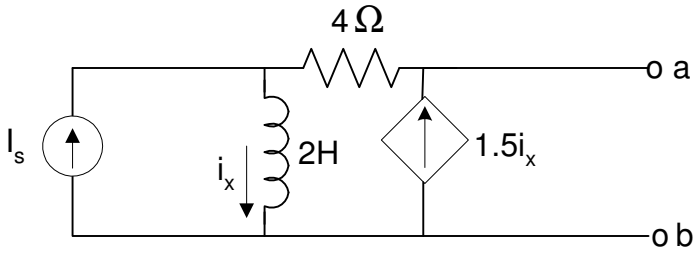
2a) (15 points) Find the transfer function $H(s) = \frac{V_o}{V_s}$.

H(s) = _____

2b) (10 points) If $V_s(t) = 6e^{-5t}u(t)$, find the COMPLETE response for $V_o(t)$.

Vo(t) = _____

Problem 3 (25 points)



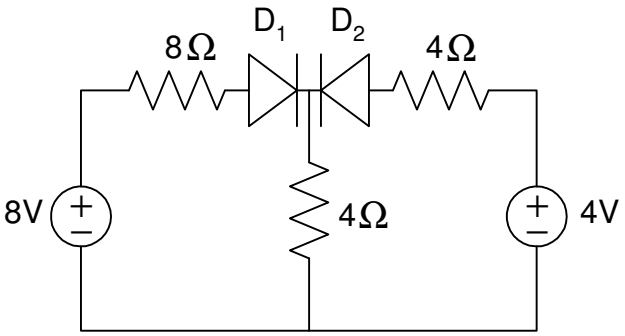
3a) (20 points) $I_s(t) = 2e^{-2t}\cos(3t)$ Amps. Find the Thevenin Equivalent of the circuit as seen by terminals a & b. The Thevenin voltage and the equivalent impedance can be expressed in rectangular or phasor notation.

Thevenin Equivalent:

3b) (5 points) If a 4H inductor is placed between terminals a and b, what is the current through it (the 4H inductor)?

$\mathbf{i_{4H}(t)=}$_____

Problem 4 (25 points)



4a) (15 points) Determine whether each diode is on or off and find the voltage at the center node with respect to the bottom node. Justify your answer or no credit will be given!

D_1:_____ **D_2:**_____

Voltage at center node: _____

4b) (10 points) What value voltage source does the 8V voltage source have to be changed to in order to make D_1 off and D_2 on? (Everything else is the same and you should give the voltage (call it V_1) in terms of an inequality)

V_1 = _____