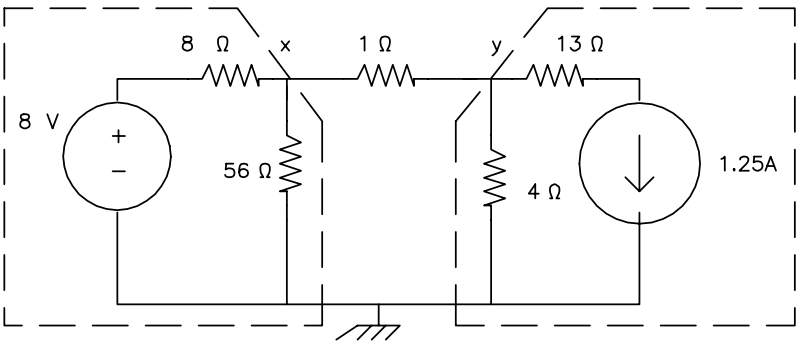
EECS 100
Spring Semester 1998
Practice Final Examination

3 Hours, Closed Book. Two: $8\frac{1}{2}$" $\times$ 11" Sheets of Notes Allowed.

May 2, 2003



1. (30 minutes) Refer to the circuit shown as Figure 1.

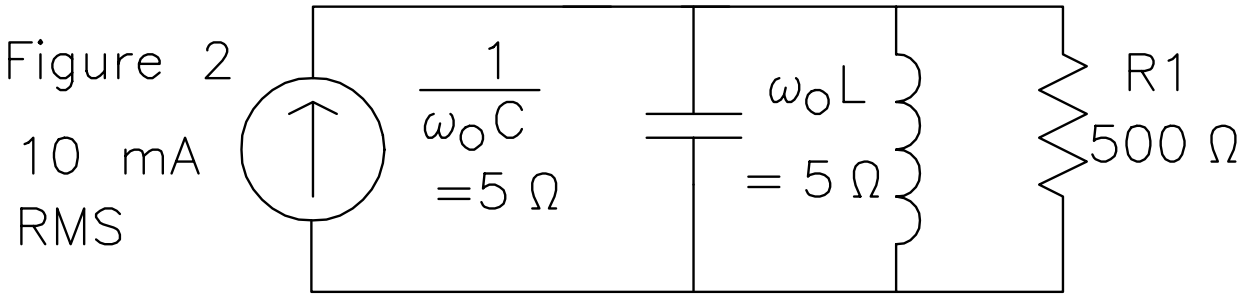
   (a) Write expressions for Kirchoff's Current Law at nodes X and Y.

   (b) Make Thevenin Equivalents for the elements inside the dashed boxes A and B.

   (c) Solve for voltages V_x and V_y.

   (d) Find the power dissipated in the network as drawn in Fig. 1.

Figure 2



2. (30 Minutes) The circuit shown in Figure 2 is a parallel resonant LRC circuit with a resonant frequency f_0 of 1.0 MHz.

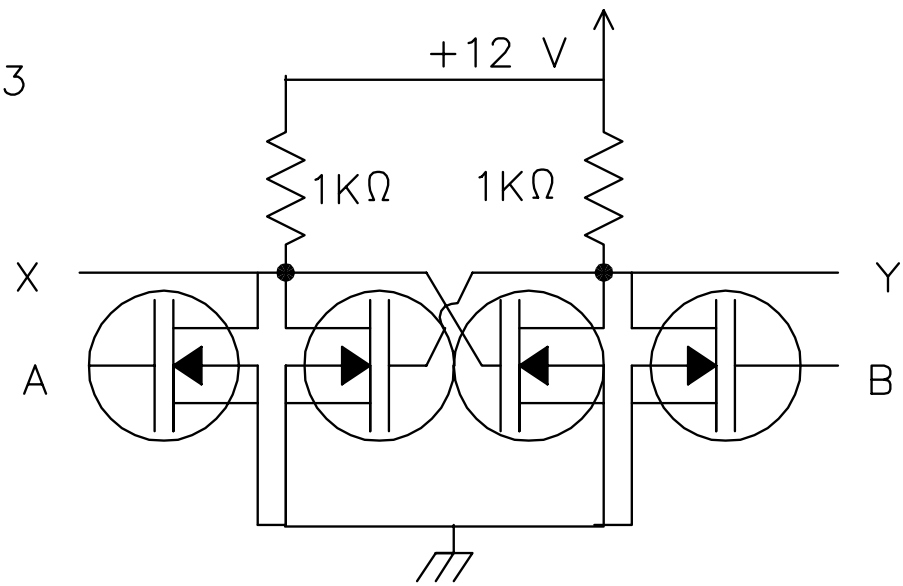
   (a) Find the values of the components L and C, in μH and μF.

   (b) Find the voltage appearing across the components at resonance.

   (c) Find the quality factor Q.

   (d) Find the frequencies at which the voltage across the components would be -3.0 dB from the voltage at resonance.

Figure 3



3. (30 minutes) In the circuit shown as Fig. 3, all four devices are n-channel MOSFETs with a value of k which is very large. Logical "1" is $4 \rightarrow 12$ volts, and the threshold voltage of the MOSFET transistors is 2.0 V. Points A and B are considered inputs, and X and Y are outputs.

   (a) Find the relation between X and Y when A and B are at logic "0".

   (b) Find the logic values of X and Y when $A = 0$, $B = 1$.

   (c) Suppose that $B = 0$ continuously, but A briefly goes to logic "1" , and then returns to zero. what would X and Y be then ?

   (d) Name the specific type of logic block that this circuit represents.

4. (30 minutes) A load manager for PG& E determines that his sector, which includes Tracy and Manteca, is drawing a total of 580 mega-volt amperes (MVA), with an overall phase angle of five degrees, lagging. However, a commercial break is coming up on "The Simpsons", which causes customers to turn up their air conditioners a notch, meaning an additional load of 70 MVA at thirty-five degrees, lagging.

   (a) Find the total load after the TV commercial: active, reactive, and apparent power.

   (b) Find the total current in each phase, if the line voltage (voltage between the phases) is 380 kilovolt RMS, and there are three phases.

   (c) If the load manager were to switch in a synchronous capacitor to provide a minimum load for his sector, what would the equivalent capacitance from each phase to ground be?

   (d) What would the adjusted power be after this correction?

5. (30 Minutes) An induction motor delivers 25 hp and runs with a real efficiency (mechanical power out / active power in) of ninety-four percent. Speed is 1746 rpm. Line voltage is 480 VRMS 3ϕ and the phase angle is ten degrees lagging. The three windings in the motor are delta-connected.

   (a) What is the slip s ?

   (b) Find the phasor current I_m in each phase of the ac line. Express in form $\mathbf{I}\angle\theta$.

   (c) Find the current in each of the delta-connected phases

   (d) Find the total reactance X'.

   (e) Find R_{stator}.

   (f) Find the reflected rotor resistance at 100 % slip, R''.

6. (30 Minutes) A synchronous machine is used to generate 60 Hz electrical energy into a resistive load. The machine operates at 3600rpm. The overall electrical demand is 800 megawatts at zero phase. The flux product in each phase provided by the rotor $N\phi_0$ is 10.0 Weber and the phases are wye-connected. The power angle δ is 30 degrees.

   (a) Find the rms line voltage (the voltage between the phases).

   (b) How many poles does this machine have?

   (c) What is the value of the reactance X_s in each phase ?

   (d) Find the excitation voltage $\mathbf{e}$. Draw a phasor diagram labeling the stator current, the stator reaction, and the excitation $\mathbf{e}$, and the output voltage (all referenced to ground) for one phase.