SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE
Fall 1999
ENSC 220
ELECTRIC CIRCUITS I
Final Examination
December 11, 1999

Attempt all four problems.
Problems are equally weighted.

1. Two ideal op-amp filters are shown in Figure 1. Assume $v_c(0_-) = 0$ in each case. For each circuit:

   - Determine the time response $v_{out}(t)$ to a unit step function at the input.
   - Sketch the function $v_{out}(t)$.
   - Determine the filter type.

2. In the circuit of Figure 2, the voltage-controlled voltage source has a gain $A > 0$.

   - Write the state equations for the circuit.
   - Write the characteristic equation.
   - Find the ranges of A for the circuit to be: (a) over-damped, (b) under-damped, (c) critically-damped, and (d) undamped.
   - Find $v_o(t)$ if $A = 1$ and all initial conditions are zero.

3. In the circuit of Figure 3, $v(t) = 96cos(10t + \pi/3)$ V.

   - Find the reactance X such that the impedance "seen" by the source is real.
   - Find the type and the value of the circuit element with reactance X.
   - For the above choice of X, find the phasor I.
   - What is the current $i(t)$ corresponding to the phasor I?

4. The circuit shown in Figure 4 employs a simple transistor model.

   - Write nodal equations.
   - Write mesh equations.
   - Check the validity of your equations by choosing appropriate value for β.

   Let $R = R_s = R_E = R_L$ and:

   - Find the Thévenin's equivalent voltage at terminals AB.
   - Find the Thévenin's equivalent resistance at terminals AB.

FIGURES:

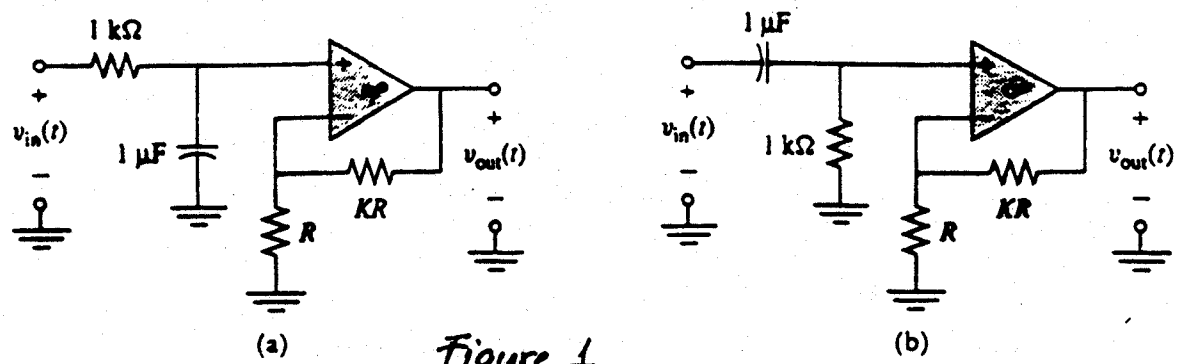

Figure 1.

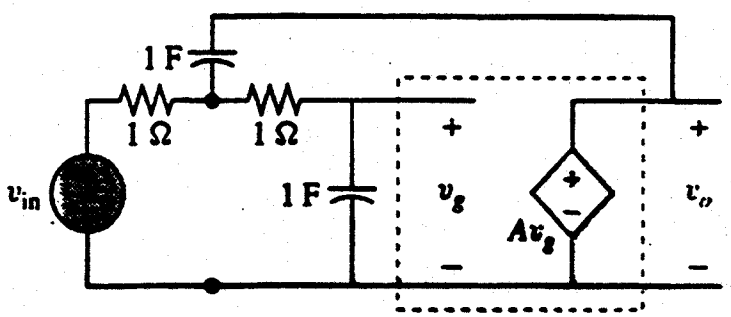

Figure 2.

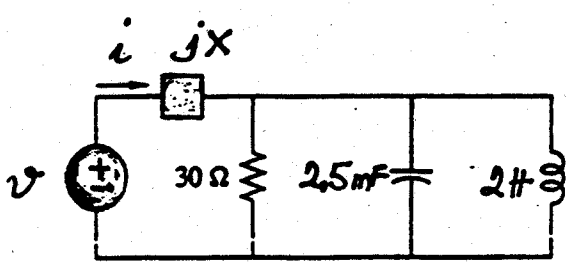

Figure 3.

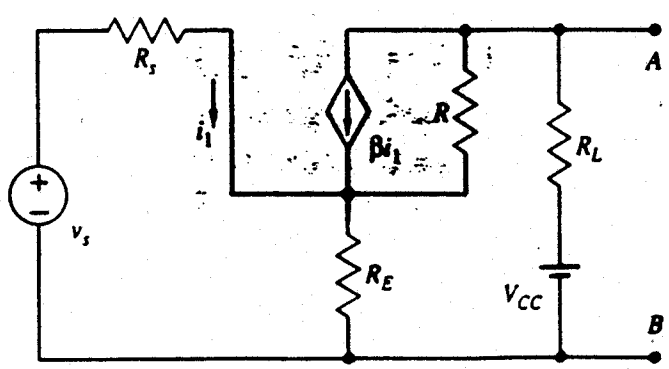

Figure 4.

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