SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

ENSC 220
ELECTRIC CIRCUITS I

Final Examination (Makeup)
February 4, 1999

Attempt all four problems. Problems are equally weighted.

1. For the circuit shown in Fig. 1 assume that $k = 2/3$.

   - Find the Thévenin's equivalent circuit between the terminals $a - b$.
   - For what value of k is the open-circuit voltage zero?
   - Determine R_{th} for that value of k.

2. The circuit shown in Fig. 2 has an ideal op-amp.

   - Obtain the differential equations for $v_{out}(t)$ by writing nodal analysis equations.
   - Determine the response to $v_{in}(t) = 1u(t)$, assuming that $v_C(0_-) = 0$.
   - What would be an appropriate name for this circuit?

3. For the circuit shown in Fig. 3:

   - Write the state equations.
   - Find the value of the negative resistance R required to generate sinusoidal oscillations with constant amplitude.

4. The circuit shown in Fig. 4 operates in a sinusoidal steady-state at the radian frequency $\omega = 1$ rad/sec.

   - Find the Thévenin's voltage circuit between the terminals $a - b$ by writing mesh equations.
   - Find the Thévenin's impedance between the terminals $a - b$ by writing nodal equations.

Fig. 1.

A circuit diagram showing a 3Ω resistor with $+V_x-$ across it, a $1v$ dependent voltage source, a 5Ω resistor, a $R \cdot V_x$ dependent current source, and a 15Ω resistor connecting to terminals a and b.

Fig. 2:

A circuit with $V_{in}(t)$, a $1k\Omega$ resistor, $1\mu F$ capacitor, an op-amp (∞), resistor R, feedback resistor KR, and output $V_{out}(t)$.

Fig. 3:

A circuit with resistor R, $3H$ inductor with i_L, 12Ω resistor, $+V_c-$ across $\frac{1}{3}F$ capacitor with current i_c, and a 2Ω resistor.

Fig. 4.

A circuit with $1\angle 0°$ A current source, $1H$ inductor, $0.25\,i_c$ dependent source, $2F$ capacitor with i_c, and output V_{ab} across terminals a and b.