SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Fall 2008
ENSC 220: ELECTRIC CIRCUITS I

Final Examination
Wednesday, December 10, 2008

Duration: 3 hours. Attempt all problems. Questions are **not** *equally weighted. Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. Formula/equation sheets, PDAs, laptops, and wireless phones are not permitted.*

1. A model of one-transistor amplifier circuit is shown in Figure 1. The transistor is modeled with the circuit connected between terminals B-C-E. Find the Thévenin's equivalent seen between the base (B) and the emitter (E) terminals using the following procedure:

   (20 points) The Thévenin's equivalent voltage:

   - Write **nodal equations** for an **appropriate circuit**.
   - Find the Thévenin's equivalent voltage V_{Th}.

   (20 points) The Thévenin's equivalent resistance:

   - Write **mesh equations** for an **appropriate circuit**.
   - Find the Thévenin's equivalent resistance R_{Th}.
   - Check your result by observing the resulting circuit when $\beta = 0$.

2. **(20 points)** The capacitor shown in Figure 2 is initially uncharged. Suppose that $v_s(t) = 2tu(t)$ (a ramp function).

   - Find capacitor voltage $v_c(t)$ for $t \geq 0$.
   - Find current $i(t)$ for $t \geq 0$.
   - Sketch $v_c(t)$ and $i(t)$ as functions of time.

3. **(20 points)** In the circuit shown in Figure 3, the switch S has been at position A for a long time and is moved to position B at $t = 0$.

   - Find $v_C(0-)$ and $i_L(0-)$.
   - Find $v_C(t)$ for $t \geq 0$.
   - Find $v_C(t)$ and $i_L(t)$ for $t \to \infty$.

4. **(20 points)** The ideal op amp circuits shown in Figure 4 operates in the sinusoidal steady-state with an input voltage $v_i(t) = V_m cos(\omega t)$.

   - Find the phasor of the output voltage V_o.
   - Find the ratio V_o/V_i.
   - Find frequency ω as a function of L and C so that the ratio does not depend of ω.
   - For this value of ω write the relationship between $v_o(t)$ and $v_i(t)$.

Fig. 1.

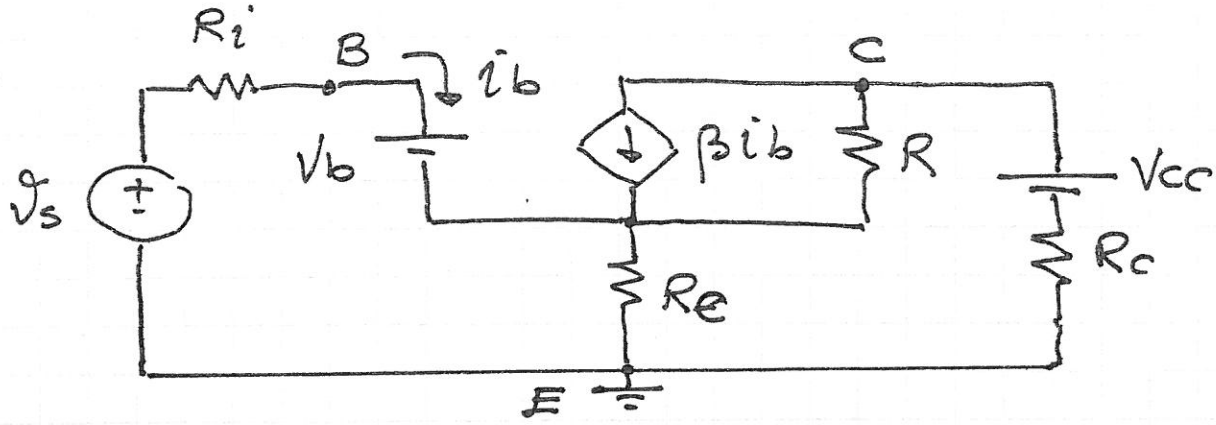

Fig. 2.

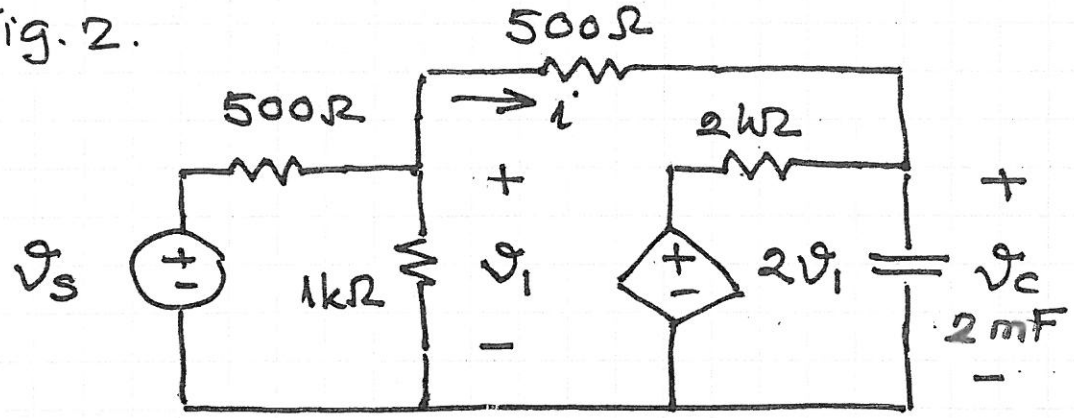

Fig. 3.

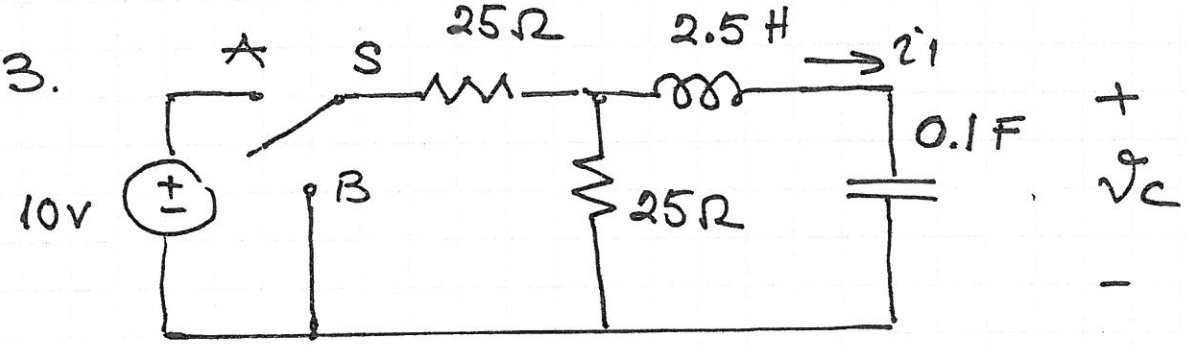

Fig. 4.