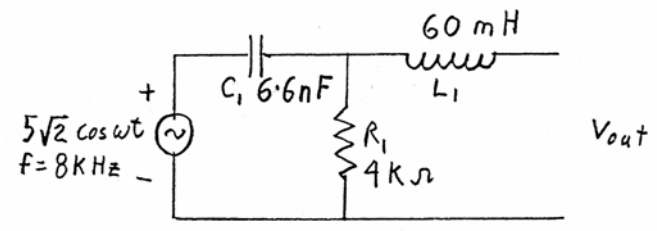
# ENSC 220 Final Term (Dec. 16, 2004)

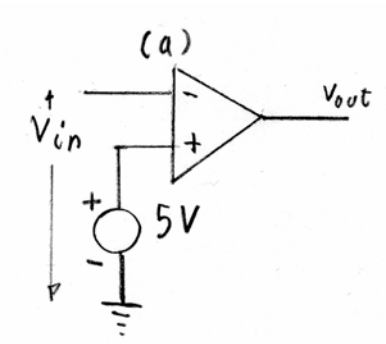
**This exam is OPEN BOOK: any book, notes and calculator may be used, but not a computer.**
**Time: 3 hours**
**NOTE: Do 3 questions in part I 16 marks each for a total of 48 marks**
**Do 2 question in part II 26 marks each for total of 52 marks.**
**Test Total is 100 marks.**

## Section 1: Do 3 of these 4 questions: 16 marks each

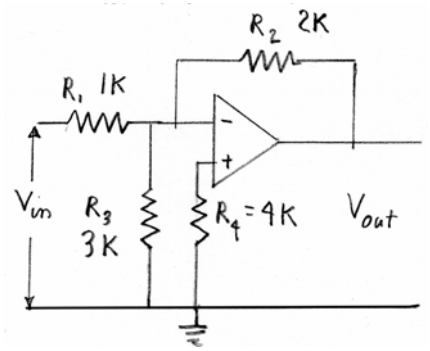
1. For the circuit below solve for I & V across each element and draw the equivalent circuits
(a) Find the Thevenin equivalent of the circuit. (6 marks)
(b) Find the Norton equivalent of the same circuit. State the Norton impedance in terms of a resistor and inductor or capacitor at this frequency. (4 marks)
(c) If the output was shorted calculate the complex power in each element. (6 marks)



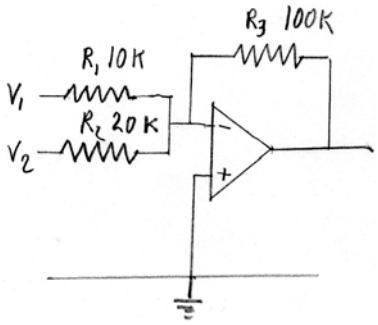

2. (a-c) In the following operational amplifier questions assume $V_{CC}$ = +15 V and $V_{EE}$ = -15 V. In all cases give a formula that relates the input voltage(s) to the output voltage and draw the output. (4 marks each part)
(d) In lab 5 explain how the touch capacitor switch turns on and off the LED signal output from the op-amps. (4 marks)




(a)




(b)

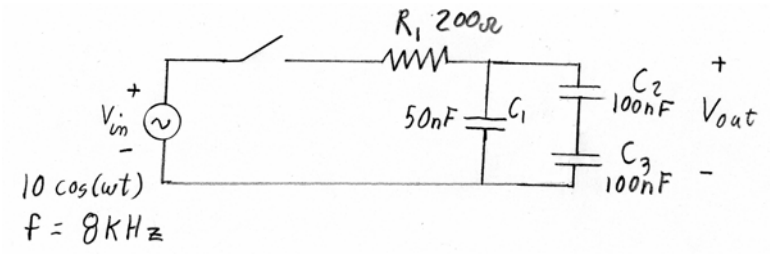



(c)

3(a) Design a series RLC circuit to select the 800 KHz AM radio band, with a bandwidth of 4 KHz. Assume the inductor used is L = 0.4 mH (8 marks)
(b) Convert the transfer function below into an S domain form. What are the values of the poles and zeros points. (2 marks)
(c) Sketch the Bode Plot for both Gain and Phase of an amplifier with that transfer function (6 marks)

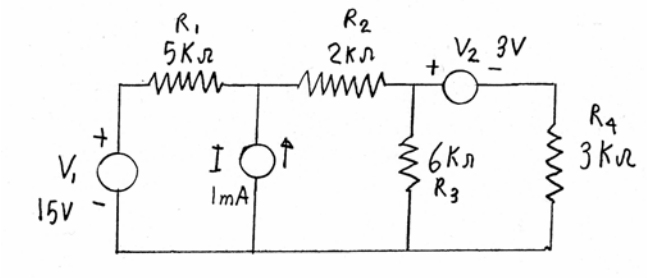
$$H(\omega) = 100\frac{j\omega}{\left(1+\frac{j\omega}{10}\right)\left(1+\frac{j\omega}{10^4}\right)\left(1+\frac{j\omega}{10^6}\right)^2}$$

4. For the following circuit
(a) Write the natural response equations for the current (7 marks)
(b) Write the long term AC response of the current after the switch is closed. Assume the switch is closed when the cosine wave is at its maximum positive value (2 marks)
(c) Solve for the complete response. (7 marks)

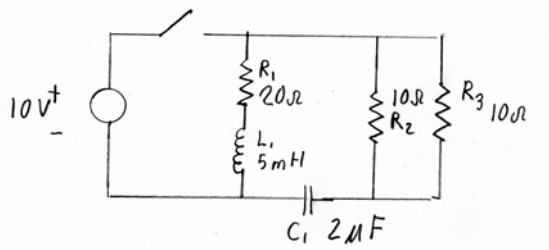



## . Section 2: Do 2 of these 3 questions: 26 marks each

5. For the following circuit
(a) Write the node equations. (4 marks)
(b) Write the mesh equations for the circuit. (6 marks)
(c) Analysize the circuit for current flowing in and voltage across each resistor and power source. (16 marks)




6 For the circuit below assume the switch has been closed long enough for the circuit to stabilize. Then the switch is opened at time t=0.
(a) Write the Differential equation for the circuit, and the initial current through or voltage across every element. (4 marks)
(b) Solve the differential equation to find the current through all the resistors. (20 marks)
(c) What damping type does this represent? What resistors values would give the other two damping types? (2 marks)




7 For the following circuit assuming all sources are at 3183 Hz with the phase relationship shown
(a) Write the node equations. (4 marks)
(b) Write the mesh equations for the circuit. (6 marks)
(c) Using nodal analysis solve the circuit for current flowing in and voltage across each impedance and power source. (16 marks)