McGill University

Faculty of Engineering

FINAL EXAMINATION

Winter 2007

FAMILY NAME (PRINT) | **FIRST NAME** (PRINT) | **SECTION** | **STUDENT I.D.**

Circuit Analysis

ECSE 210

Examiner : Prof. M. D. Levine | **Co-Examiner : Prof. R. Khazaka**

Signature: | **Signature:**

***Date*: Monday, April 16, 2007** | ***Time*: 2:00 PM**

INSTRUCTIONS

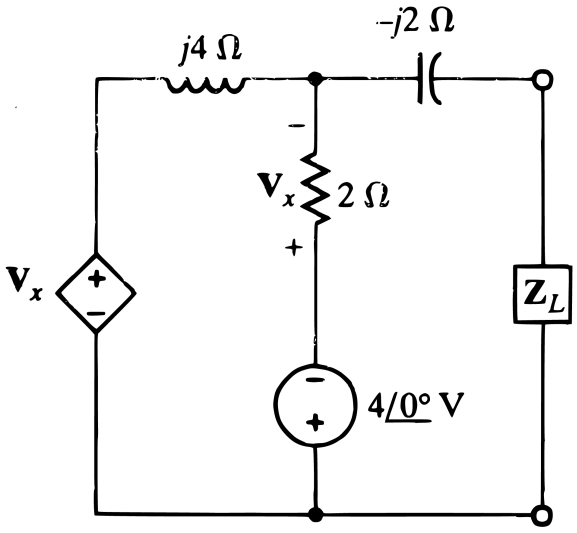
- **Explain clearly the steps in your solution.**
- **Use either a pen or HB pencil.**
- **The total number of points in this examination is 35, which will be pro-rated to 70% of the final grade.**
- **This is a closed book examination.**
- **Make sure that your solutions are written on the *consecutive* pages provided. Four extra pages may be found at the end.**
- **You are permitted regular and translation dictionaries.**
- **Faculty standard calculator permitted only.**
- **This examination paper must be returned.**

EVALUATION OF EXAM PAPER	Question #	1	2	3	4	5	6
	weight	*6*	*6*	*5*	*6*	*5*	*7*
	score						

Total Score | |

[6 marks]

1. **Consider the circuit below having a 60Hz ac source:**
   - **(a) Determine the value of Z_L for maximum average power transfer.**
     [4 marks]
   - **(b) Determine the maximum average power delivered to the load Z_L.**
     [1 mark]
   - **(c) Determine the component values for the Z_L equivalent circuit.**
     [1 mark]



Write the final answer on page 5.

Write the final answer for Question 1 here:

[6 marks]

2. **(a) A three-phase balanced wye-delta system has a line voltage of 208 V rms. The total real power absorbed by the loads is 1200 W and the power factor angle of each load is 20° lagging. Determine the magnitude of the line current and the load impedance per phase in the delta.** [3 marks]

(b) Consider a balanced three-phase wye-connected source feeding a balanced three-phase load. The line voltage is 34.5 kV rms at 60 Hz. The balanced three-phase load consumes a total of 24 MVA at 0.78 power factor lagging. Power factor correction of the load is to be achieved by using three identical capacitors, each one placed across each pair of line-to-neutral voltages. Determine the value of the capacitor such that the resulting augmented load has a power factor of 0.94 leading. [3 marks]

Write the final answer on page 9.

Write the final answer for Question 2 here:

[5 marks]

3. A load operates at 20kW, 0.8 pf lagging. The load voltage is $220\angle 0°$ V rms at 60 Hertz. The impedance of the line is $0.09+j0.3\ \Omega$.

   (a) Determine the source voltage $v_s(t)$. [4 marks]

   (b) Determine the power factor at the input of the line. [1 mark]

Write the final answer on page 13.

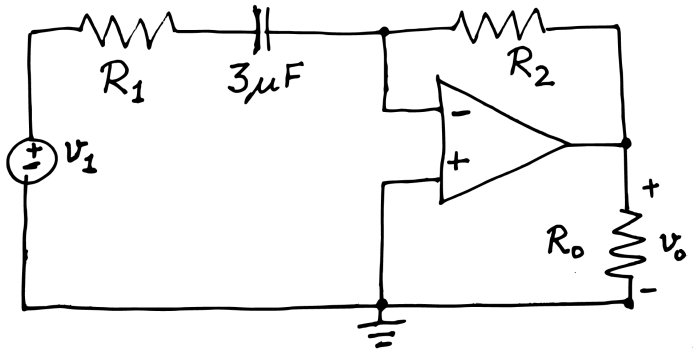
Write the final answer for Question 3 here:

[6 marks]

4. **(a) Determine the values of R_1 and R_2 in Fig. 4(b) so that the circuit has the asymptotic Bode plot shown in Fig. 4(a).**
   [4 marks]

   (b) Sketch the pole-zero plot for the circuit in Fig. 4(b).
   [1 mark]

   (c) Is the circuit in Fig. 4(b) stable or unstable? Explain your answer in one sentence.

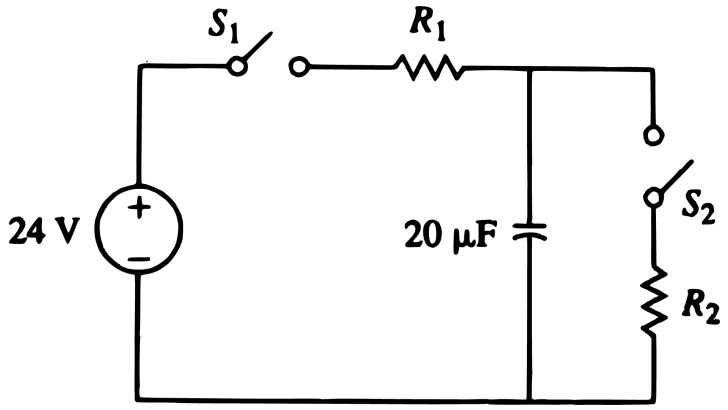


Write the final answer on page 17.

Write the final answer for Question 4 here:

[5 marks]

5. **The circuit below is initially at rest. It uses switch-1 and R_1 to permit the capacitor to charge during a specified time interval and uses switch-2 and R_2 to hold the charge at the specified level.**
   - **(a) Select the value of R_1 to make the capacitor charge to 16 Volts in 20 milliseconds. [4 marks]**
   - **(b) Then select the value of R_2 to hold the capacitor voltage to 16 Volts. [1 mark]**



Write the final answer on page 21.

Write the final answer for Question 5 here:

[7 marks]

6. The figure below shows the magnitude frequency response plot for a parallel RLC resonant circuit.

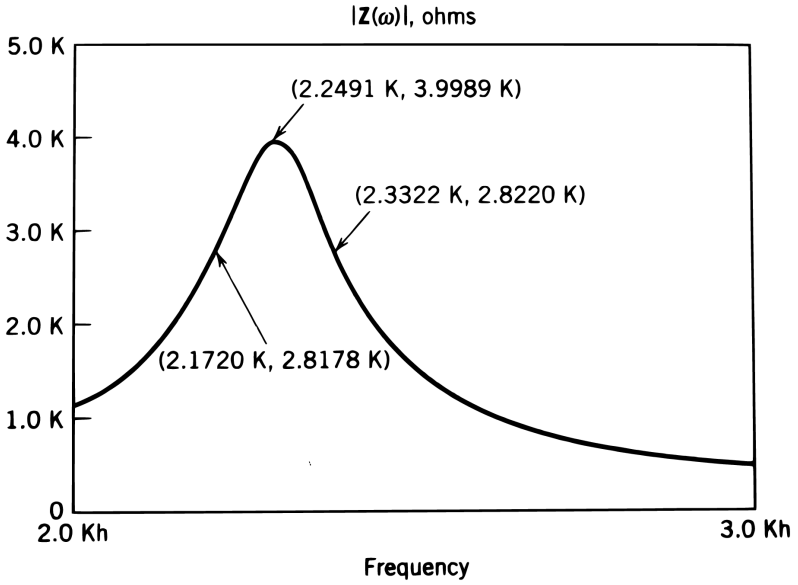
(a) Determine the gain *k* at resonance. [1 mark]

(b) Determine the quality factor *Q*. [2 marks]

(c) Determine the resonant frequency ω_o. [1 mark]

(d) What is the network function Z (ω)? [1 mark]

(e) Determine the values of L and C for this parallel RLC resonant circuit. [2 marks]



Write the final answer on page 25.

Write the final answer for Question 6 here: