McGill University
Faculty of Engineering

FINAL EXAMINATION
Winter 2006

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

Circuit Analysis
ECSE 210

Examiner: Prof. M. D. Levine
Signature: Martin Levine

Co-Examiner: Prof. R. Khazaka
Signature: R. Khazaka

***Date*:** Tuesday, April 11, 2006

***Time*:** 2:00 PM

INSTRUCTIONS

- 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	8	6	5	4
score						

Total Score ____

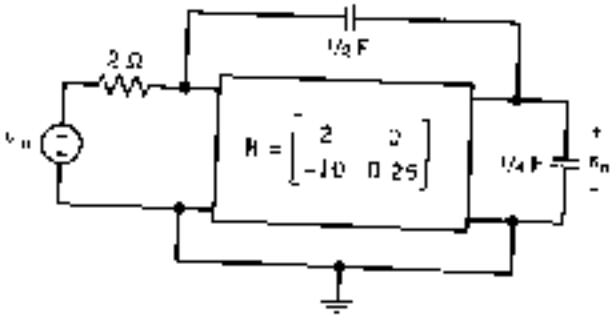
[6 marks]

1. **The circuit below, containing a two-port with a hybrid parameter matrix H within it, was designed to have a transfer function given by:**

$$\frac{V_o(s)}{V_{in}(s)} = \frac{2s-10}{s^2+27s+2}$$

(a) Sketch the h-parameter *equivalent* model for the two-port.
(2 marks)

(b) Determine whether the circuit in the figure satisfies the above transfer function. Show the details of your analysis.
(4 marks)



Write the final answer on page 6.

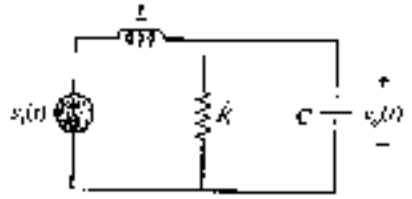
[6 marks]

2. Consider the circuit shown below.

(a) Determine the type of filter that the circuit represents. Explain your reasoning. (3 marks)

(b) Calculate the corner or cutoff frequency when R=2kΩ, L=2H and C=2μF.

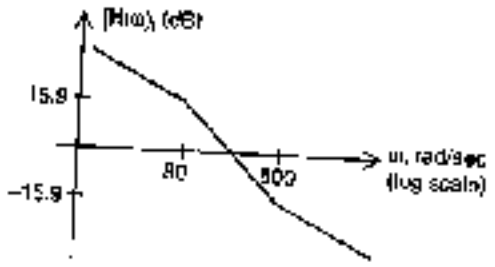
(3 marks)



Write the final answer on page 10.

[8 marks]

3. **Determine the transfer function H(s) for the amplitude Bode plot shown below.**



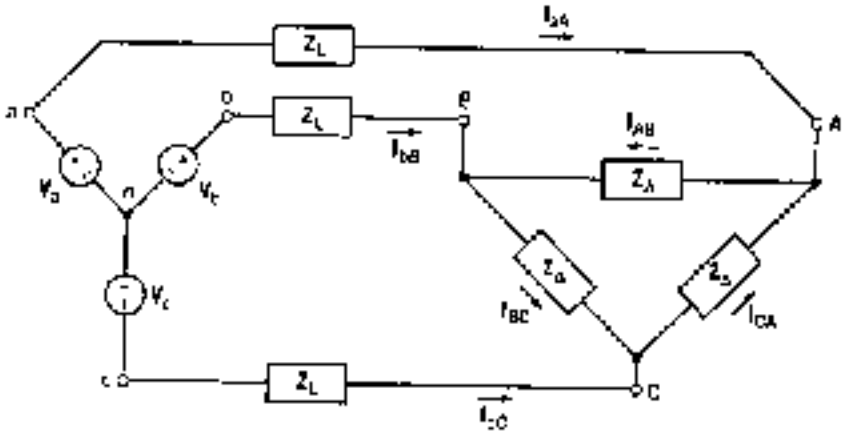
Write the final answer on page 14.

[6 marks]

4. **The figure below shows a balanced Y-to-Δ three-phase circuit. The phase voltages of the Y-connected source are V_a=110∠0° V rms, V_b=110∠-120° V rms, and V_c=110∠+120° V rms. The line impedances are each Z_L=10+*j*5 Ω. The impedances of the Δ-connected load are each Z_Δ=75+*j*225 Ω.**

   (a) Determine the phase currents in the Δ-connected load. (5 marks)

   (b) Determine the total average power delivered to the load. (1 mark)



Write the final answer on page 18.

[5 marks]

5. The input to the circuit shown below is the voltage of the ~~current~~ source,

VD Usage

$$v_s(t)=7.28\cos(4t+77°)\ \text{V}$$

The output is the voltage across the inductor,

$$v_o(t)=4.254\cos(4t+311°)\ \text{V}$$

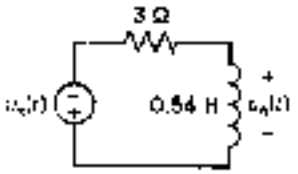
Determine the following:

(a) The average power supplied by the voltage source (2 marks)

(b) The average power received by the resistor (1 mark)

(c) The average power received by the inductor (1 mark)

(d) The power factor of the impedance of the series connection of the resistor and inductor (1 mark)



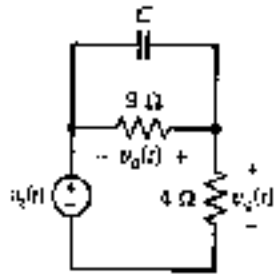
Write the final answer on page 22.

[4 marks]

6. **Consider the circuit shown below. The input to the circuit is the voltage source, $v_s(t)$, and the output is the voltage across the 4 Ω resistor. When the input is $v_s(t)=8.93\cos(2t+54°)$ V, the corresponding output is $v_o(t)=3.83\cos(4t+83°)$ V.**

   (a) Determine the voltage, $v_x(t)$, across the 9 Ω resistor. (2 marks)

   (b) Determine the value of the capacitance C. (2 marks)



Write the final answer on page 26.