CARLETON UNIVERSITY

Final Examination
December 15th, 2017

Duration: 3 hours
# of Students: 472
Department Name & Course #: Electronics ELEC 2501 A, B
Course Instructor: P. Gunupudi

AUTHORIZED MEMORANDA:

- NON-PROGRAMMABLE, NON-GRAPHING CALCULATORS.

- STUDENTS **MUST** COUNT THE NUMBER OF QUESTIONS **BEFORE** BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY IMMEDIATELY TO THE PROCTOR. THIS EXAM HAS 12 PAGES INCLUDING THIS COVER PAGE.
- THE TEST PAPERS **MAY NOT** BE TAKEN FROM THE EXAMINATION ROOM.
- IN ADDITION TO THIS QUESTION PAPER, STUDENTS REQUIRE:

  an examination booklet: **NO**
  a Scantron sheet: **NO**

INSTRUCTIONS AND INFORMATION:

- PRINT YOUR NAME AND STUDENT NUMBER CLEARLY.

  Name: _____

  Student Number: _____

- WRITE YOUR NAME AND STUDENT NUMBER ON ALL PAGES.
- ATTEMPT ALL QUESTIONS.
- PUT YOUR ANSWERS IN THE SPACES PROVIDED.
- FULL MARKS FOR EACH QUESTION ARE INDICATED. Part marks are available depending on the question.
- THIS EXAM HAS 8 QUESTIONS, FOR A TOTAL OF 100 POINTS.

For faculty use only:

Page:	1	2	3	4	5	6	7	8	9	10	11	Total
Points:	8	8	10	10	6	12	12	10	8	8	8	100
Score:												

Student Name: **Student Number:**

Question 1 ..... *(16 points)*

RMS Value and Power

(a) For the periodic waveform in Figure 1 find the RMS value. /8

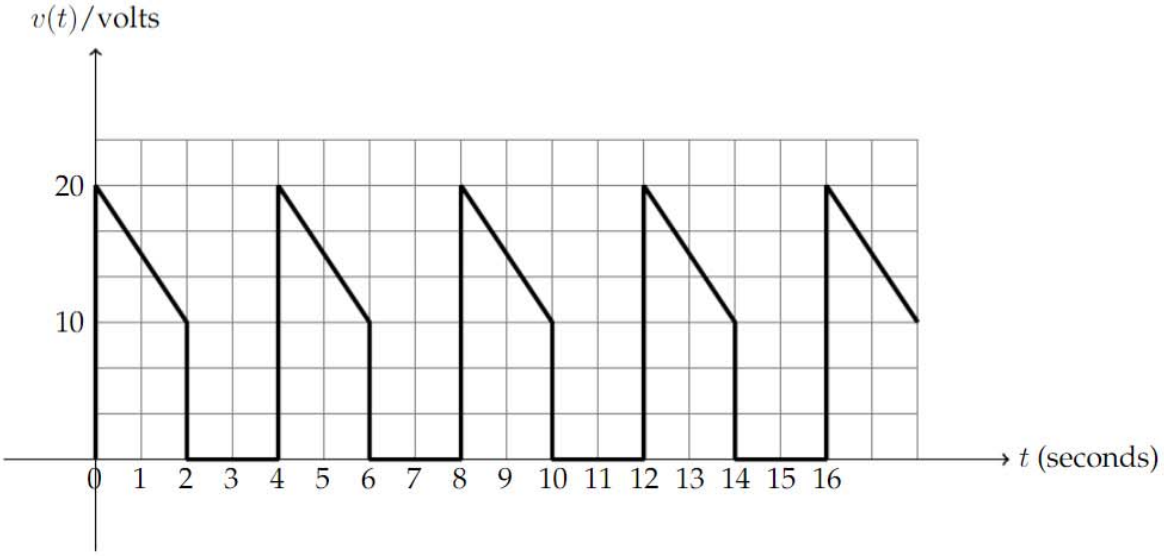


Figure 1: A periodic waveform.

Answer: RMS= _____

(b) Given the circuit of Figure 2, /8

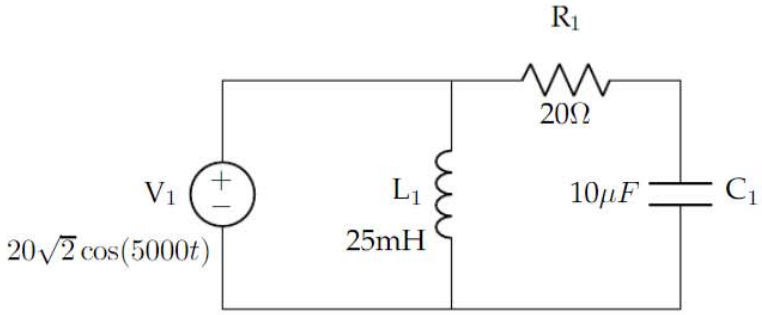


Figure 2: Circuit for power analysis.

b.i) What is the average power dissipated in R_1?

Answer: Power in R_1 (in watts): _____

b.ii) What is the average power dissipated in L_1?

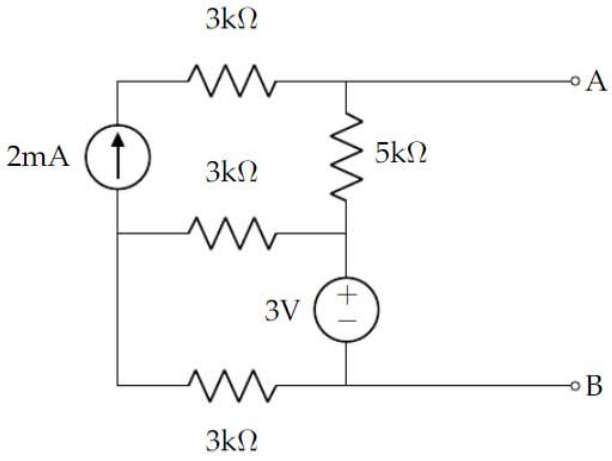
Answer: Power in L_1 (in watts): _____

Student Name: **Student Number:**

Question 2 ..... *(10 points)*

Thévenin

(a) For the circuit shown in Figure 3 find the Thévenin equivalent between the terminals A and B. /8



Answer: Thévenin equivalent:

Figure 3: Circuit for Thévenin equivalent question.

(b) For the circuit in Figure 3 what value of load resistor should be connected between the terminals A and B to ensure maximum power transfer to the load?

Answer: Value of load resistor: _____ /2

Student Name: **Student Number:**

Question 3 ..... *(10 points)*

Nodal Analysis and Loop Analysis

(a) Given the circuit of Figure 4, write the nodal equations for nodes V_1, V_2, and V_3 using the convention that currents leaving a node are considered positive. There is no need to simplify your equations.

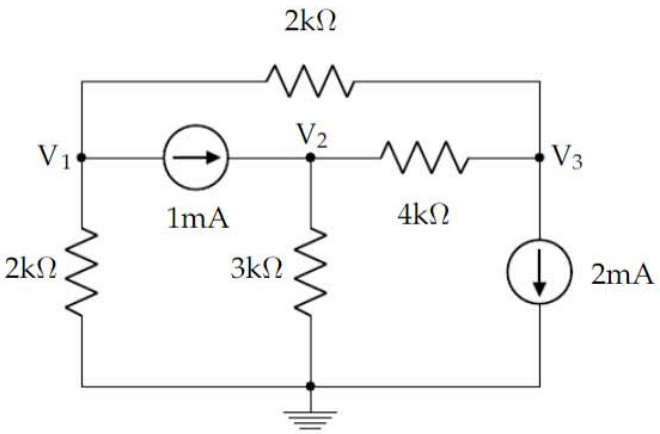


Figure 4: Circuit for Nodal analysis.

a.i) Answer: V_1 nodal equation: _____ /2

a.ii) Answer: V_2 nodal equation: _____ /2

a.iii) Answer: V_3 nodal equation: _____ /2

(b) Given the circuit of Figure 5, write the loop equations for loops I_1 and I_2. There is no need to simplify your equations.

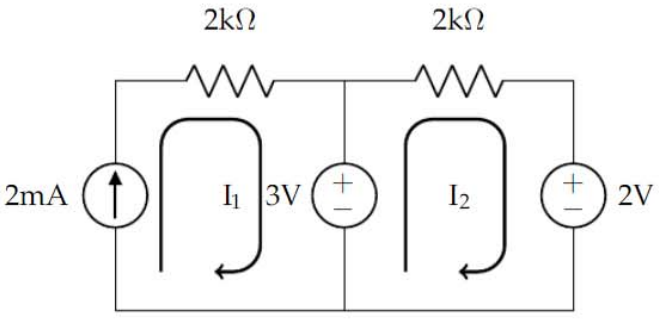


Figure 5: Circuit for Loop analysis.

b.i) Answer: Loop equation for I_1: _____ /2

b.ii) Answer: Loop equation for I_2: _____ /2

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Question 4 ..... *(18 points)*

Phasor Analysis

Note: Answers have to be given in rectangular or polar form as specified. Answers must be simplified, ie. $100 - j50\Omega$ or $10\angle 60° V$, etc.

(a) Given the circuit of Figure 6,

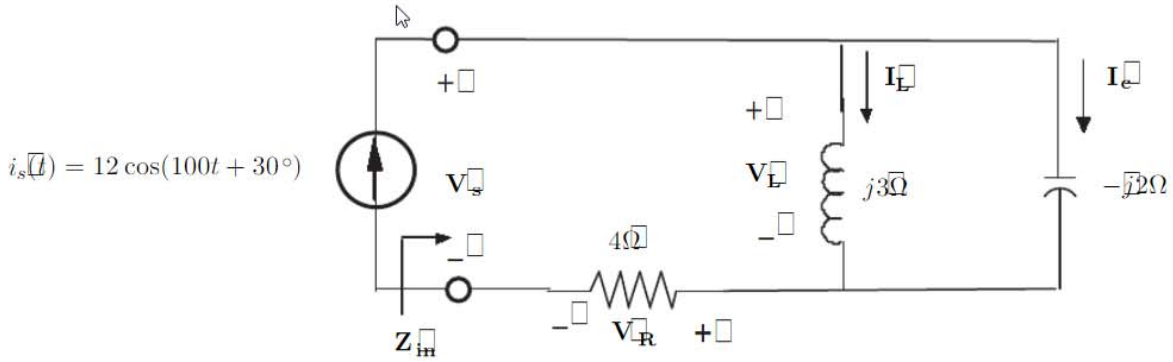

Figure 6: Circuit for phasor analysis.

a.i) Calculate the voltage $\mathbf{V_s}$ across the current source.

Answer (polar): _____

/6

a.ii) Calculate the inductor current $\mathbf{I_L}$.

Answer (polar): _____

/6

Resonance

(b) A series resonance circuit is to have a resonance frequency of 200kHz and is to use L=1mH.

b.i) What capacitance value C is required?

Answer: _____

/2

b.ii) What resistance value is required for $Q = 25$?

Answer: _____

/2

b.iii) In a series resonance circuit how many degrees out of phase are the capacitor and inductor voltages at resonance?

Answer: _____

/2

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Question 5 ..... *(12 points)*

Bode Plot Questions

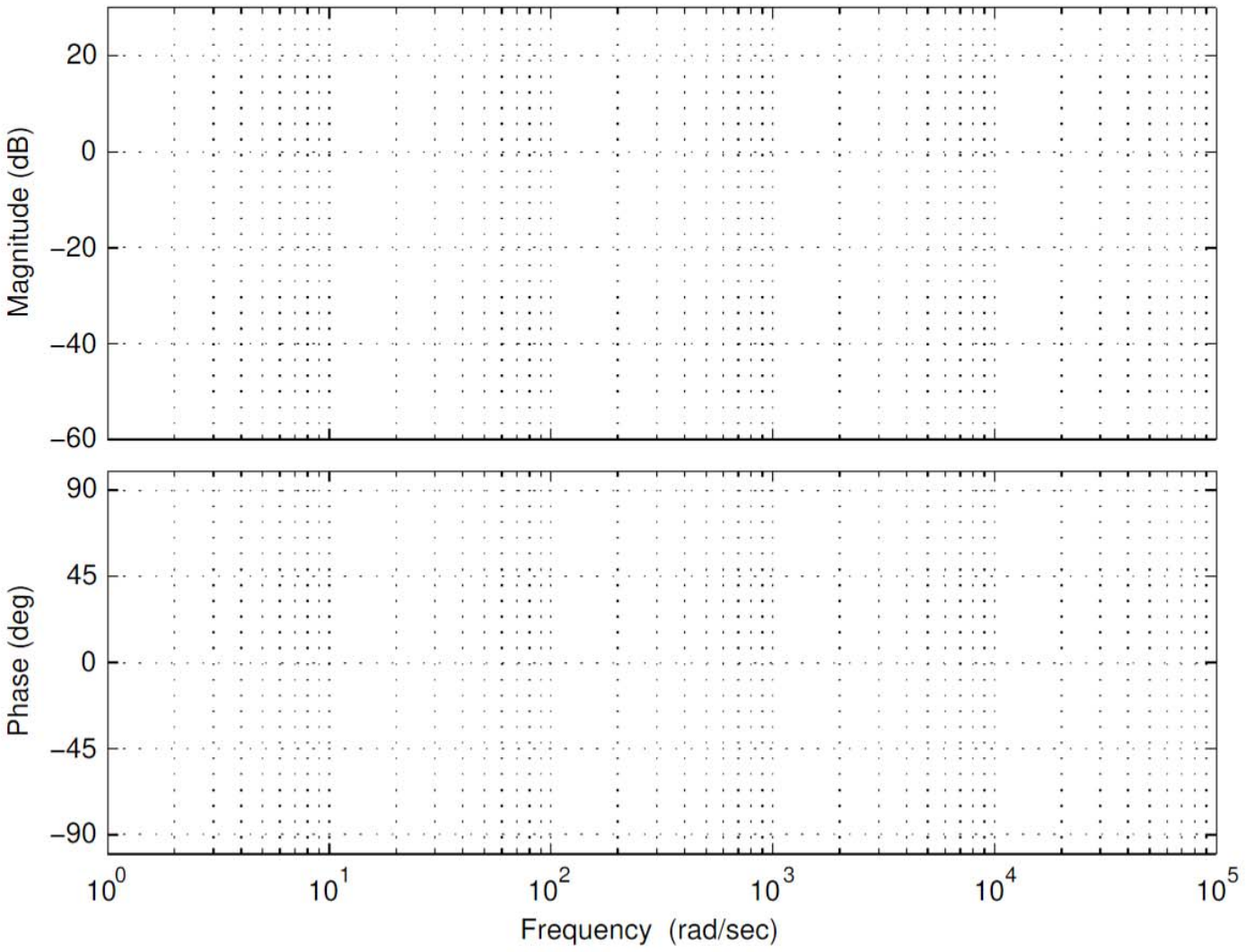
Given the transfer function $\mathbf{H}(j\omega) = \dfrac{2000}{j\omega 5 + 200}$, answer the following:

(a) What is the corner frequency in radians per second?

Answer: The corner frequency is _____

/2

(b) Draw the magnitude and phase Bode plots below. For the magnitude plot, include both the straight line (asymptotic) approximate plots as well as a sketch of the actual curve. For the magnitude plot, indicate the value of any slope(s) and the value of the difference between the straight line approximation and the actual curve at the corner frequency. Label all important frequencies, magnitudes and angles.



/10

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Question 6 ..... *(10 points)*

Transient Analysis Question

(a) In the circuit shown in Fig. 7, the switch has been closed for all of time $t < 0$. At $t = 0$ the switch is opened. Derive an expression for the capacitor voltage $v_c(t)$ for $t > 0$.

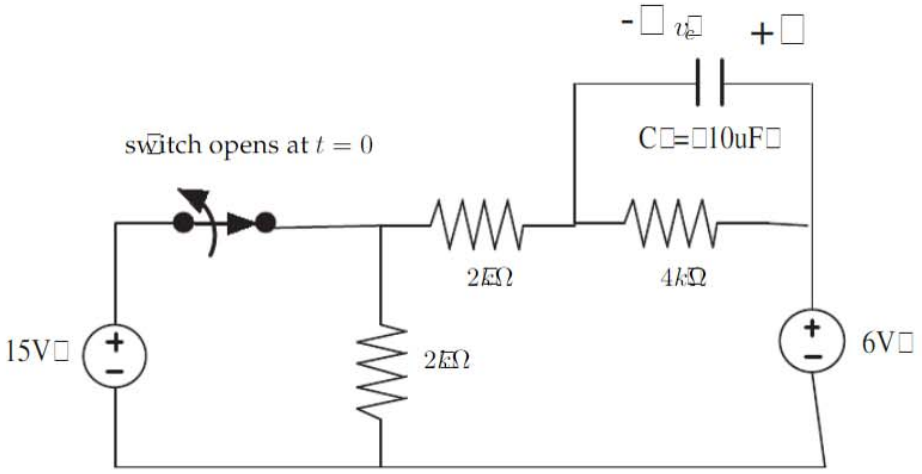

Figure 7: Capacitor transient circuit.

Answer: _____

/10

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Question 7 ..... *(8 points)*

Knowledge Base Questions

(a) What is the equation relating the charge (q) and voltage (v) of a capacitor of value C?

/1

(b) State the equation governing voltage (v) and current (i) of an inductor of value L.

/1

(c) What is the equation governing the quality factor (Q) of a series resonant circuit in terms of the resonant frequency (ω_0), the inductance (L) and the resistance (R)?

/1

(d) The effective resistance of two resistances R_1 and R_2 in parallel is

/1

(e) The effective capacitance of two capacitors C_1 and C_2 in series is

/1

(f) The impedance of an inductor L at a frequency f is

/1

(g) The effective admittance of two admittances $\mathbf{Y}_1$ and $\mathbf{Y}_2$ in parallel with each other is

/1

(h) The average power of a purely reactive circuit is

/1

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Question 8 ..... *(16 points)*

Problem Analysis Question

Given the circuit in Figure 8 find the current in the $2k\Omega$ resistor. The magnitude of the current as well as the direction of the current (A $\rightarrow$ B or B $\rightarrow$ A) must be determined.

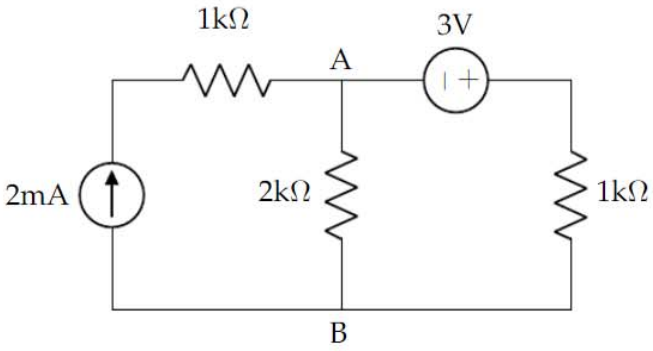

Figure 8: Circuit for problem analysis.

(a) Describe the different approaches you can think of to solve this problem. Which approach would you choose and why? /4

(b) State any assumptions you need to make to solve the problem (i.e. direction of currents etc.). Comment on the impact your assumptions may have on your solution. /4

(c) Present your solution to the problem. /4

(d) Do your results make sense? Why do you think so? /4

HAPPY HOLIDAYS