ECE 2040 Exam 2
Fall 2024

Name ______________________________

General Instructions:

- Exam is closed book / closed notes other than the one-page of handwritten notes.
- Choose the best possible answer available in all cases.
- Blank scratch paper is allowed

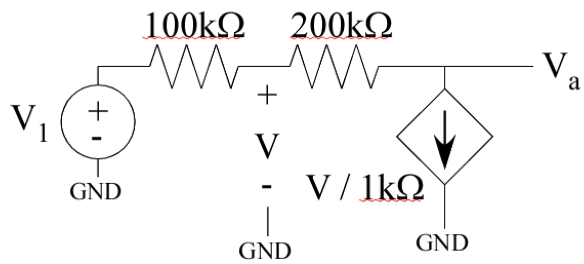
_______ Part I: Objective Questions

_______ Part II: Open Response Question
(In the following pages)

_______ Final Score

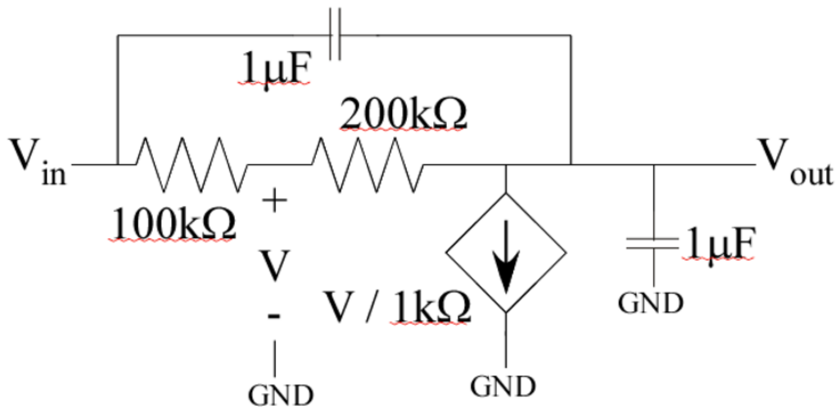
Part II: Open Response Question (20 points)

Find the one-port equivalent at Node V_a for the following circuit:



The rest of the problem will analyze the following circuit. You need to demonstrate and show your reasoning for:

- Differential Equation between V_{in} and V_{out}
- Transfer Function
- Step Response for Vin = u(t) (1V)
- Frequency Response
- Gain as input frequency goes to infinity
- Gain as input frequency goes to zero



ECE 2040 Exam 2
Fall 2024
Part I: Objective Questions

Name ______________________________

Each question is worth 4 points.
All of your answers need to be on this sheet.
Only the final answers, as indicated by the question, will be considered correct for each question.

Choose the best possible answer available in all cases.

1. ________________	11. ________________
2. ________________	12. ________________
3. ________________	13. ________________
4. ________________	14. ________________
5. ________________	15. ________________
6. ________________	16. ________________
7. ________________	17. ________________
8. ________________	18. ________________
9. ________________	19. ________________
10. ________________	20. ________________

Choose the best answer possible.

1. What is the time-constant for a resistance of $10G\Omega$ and capacitance of 10fF?

2. What is the time-constant for an inductor of $1\mu H$ and a resistance of $10k\Omega$?

a. 100ps
b. 1ns
c. 10ns
d. 100ns
e. $1\mu s$
f. $10\mu s$
g. $100\mu s$
h. 1ms
i. 10ms
j. 100ms
h. 1s

Match the following items:

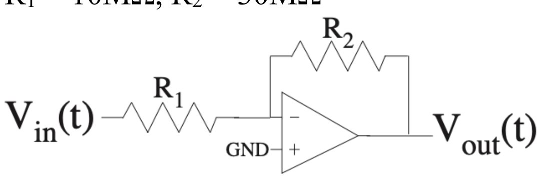
3. $\dfrac{\tau}{\tau s + 1}$

4. $\dfrac{1}{s(\tau s + 1)}$

5. $\dfrac{1}{s}$

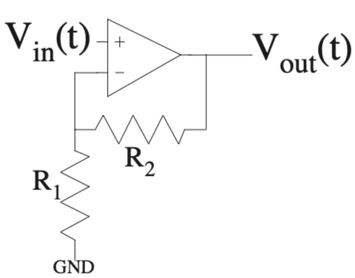
a. $\delta(t)$
b. $u(t)$
c. $e^{-t/\tau}\,\delta(t)$
d. $e^{-t/\tau}\,u(t)$
e. $(1 - e^{-t/\tau})\,\delta(t)$
f. $(1 - e^{-t/\tau})\,u(t)$

$R_1 = 10M\Omega$, $R_2 = 30M\Omega$



6. What is the Signal Gain?
a. -4
b. -3
c. -2
d. -1
e. 0
f. 1
g. 2
h. 3
i. 4

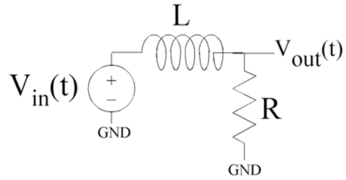
7. What is the Input Resistance?
a. 0
b. $10k\Omega$
c. $30k\Omega$
d. $100k\Omega$
e. $300k\Omega$
f. $1M\Omega$
g. $3M\Omega$
h. $10M\Omega$
i. $30M\Omega$
j. Infinite



8. What is the Signal Gain?
a. -4
b. -3
c. -2
d. -1
e. 0
f. 1
g. 2
h. 3
i. 4

Consider the following circuits: C = 1µF, R = 2kΩ, L = 1mH, R_1 = 1kΩ, R_2 = 2kΩ

9.



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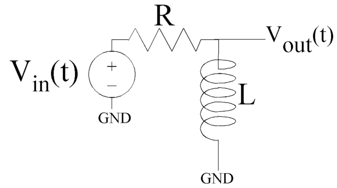

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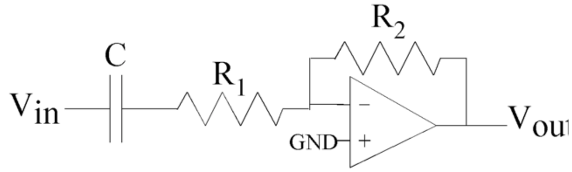

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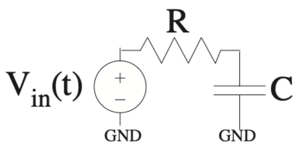

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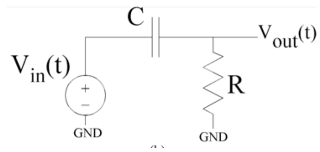
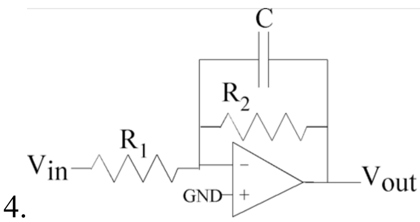




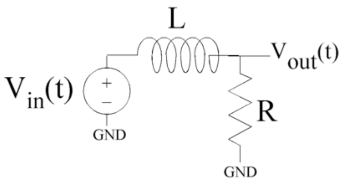
14.

Match these circuits to the following responses to a unit step function (Vin = (1V) u(t)):

a. $e^{-t/1ms}$ u(t)	i. $-e^{-t/0.5\mu s}$ u(t)	q. $2e^{-t/1\mu s}$ u(t)	y. $-2e^{-t/1ms}$ u(t)
b. $e^{-t/2ms}$ u(t)	j. $-e^{-t/2\mu s}$ u(t)	r. $2e^{-t/2\mu s}$ u(t)	z. $-2e^{-t/2ms}$ u(t)
c. (1 - $e^{-t/1ms}$) u(t)	k. $-e^{-t/1ms}$ u(t)	s. $2e^{-t/1ms}$ u(t)	α. $-2e^{-t/1\mu s}$ u(t)
d. (1 - $e^{-t/2ms}$) u(t)	l. $-e^{-t/2ms}$ u(t)	t. $2e^{-t/2ms}$ u(t)	β. $-2e^{-t/2\mu s}$ u(t)
e. $e^{-t/0.5\mu s}$ u(t)	m. -(1 - $e^{-t/1ms}$) u(t)	u. 2(1 - $e^{-t/1\mu s}$) u(t)	δ. -2(1 - $e^{-t/1ms}$) u(t)
f. $e^{-t/1\mu s}$ u(t)	n. -(1 - $e^{-t/2ms}$) u(t)	v. 2(1 - $e^{-t/2\mu s}$) u(t)	γ. -2(1 - $e^{-t/2ms}$) u(t)
g. (1 - $e^{-t/0.5\mu s}$) u(t)	o. -(1 - $e^{-t/1\mu s}$) u(t)	w. 2(1 - $e^{-t/1\mu s}$) u(t)	ε. -2(1 - $e^{-t/1\mu s}$) u(t)
h. (1 - $e^{-t/1\mu s}$) u(t)	p. -(1 - $e^{-t/2\mu}$) u(t)	x. 2(1 - $e^{-t/2\mu}$) u(t)	φ. -2(1 - $e^{-t/2\mu s}$) u(t)

Consider the following circuits: C = 1μF, R = 2kΩ, L = 1mH, R_1 = 1kΩ, R_2 = 2kΩ

A:



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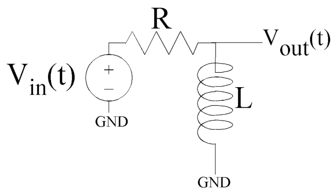

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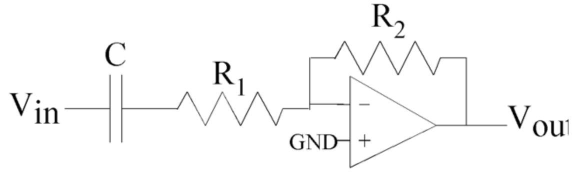

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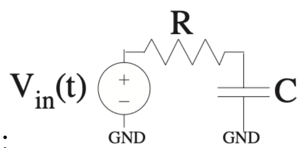
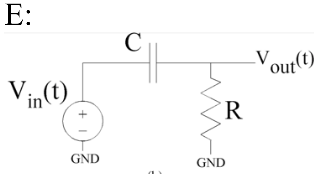
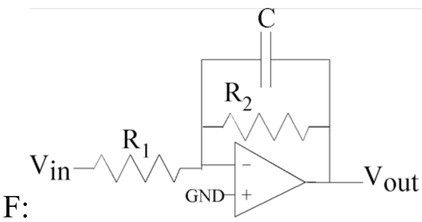


E:

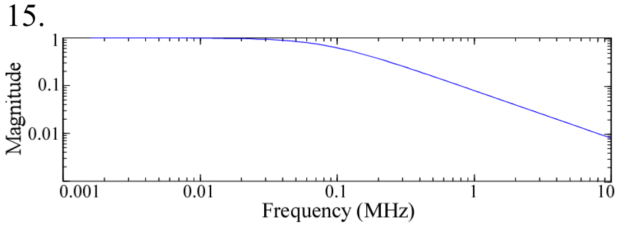


F:

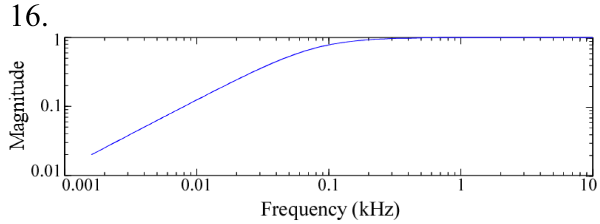


Match the following Frequency Responses:

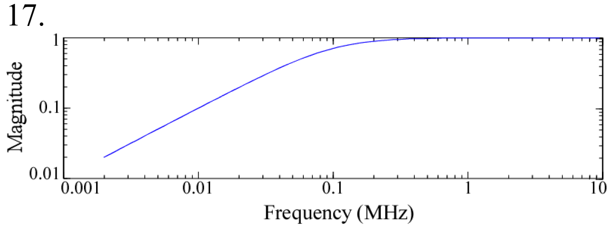
15.



16.



17.



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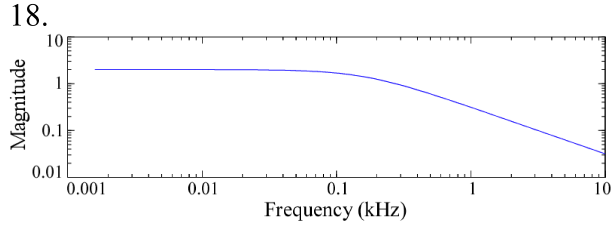

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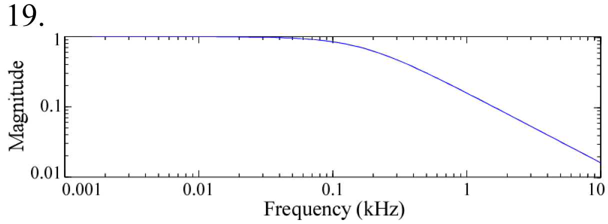

20.