Electrical Engineering
EECE2210 — Fall 2021
Exam #1

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Name: _____

General Rules:

- You may make use of two sheets of notes, 8.5–by–11 inches, using both sides of the page.
- You may use a calculator.
- Present your work as clearly as possible. I give partial credit if I can figure out that you know what you are doing. I do not give credit for putting down everything you know and hoping I will find something correct in it.
- For the first problem, place an X in the box corresponding to the best answer. For the remaining problems, please put your answer on the answer sheet provided on the last page.
- Avoid any appearance of academic dishonesty. Do not talk to other students during the exam. Keep phones, computers, and other electronic devices other than calculators secured and out of reach.

1 Short–Answer Questions: 25 Points

In node analysis, we use

- [ ] KCL and solve for unknown currents
- [x] KCL and solve for unknown voltages
- [ ] KVL and solve for unknown currents
- [ ] KVL and solve for unknown voltages

A good voltmeter has a high input resistance.

- [x] True
- [ ] False

It is OK to use a 20-Ohm, 10-Watt resistor when a circuit calls for a 20-Ohm, 1-Watt resistor

- [x] True
- [ ] False

The resistance value of a parallel combination of two resistors is between the resistance values of the two individual ones.

- [ ] True
- [x] False

The resistance of a wire is proportional to

- [ ] its radius
- [ ] its radius squared
- [x] its length

We measure a signal of 14 Volts peak–to–peak on an oscilloscope. The RMS voltage is closest to (pick the one best answer)

- [ ] 14 V
- [ ] 7 V
- [x] 5 V

It is necessary to break a circuit to install an ammeter

- [x] True
- [ ] False

A realistic voltage source consists of an ideal voltage source in series with a resistor.

☒ True ☐ False

An operational amplifier theoretically has an open–loop gain of

oops; bad question

☐ 0 Ohms
☐ 50 Ohms
☒ Infinity

An operational amplifier in saturation produces an output equal to

☐ 0 Volts
☐ Infinity
☒ One of the power supply voltages

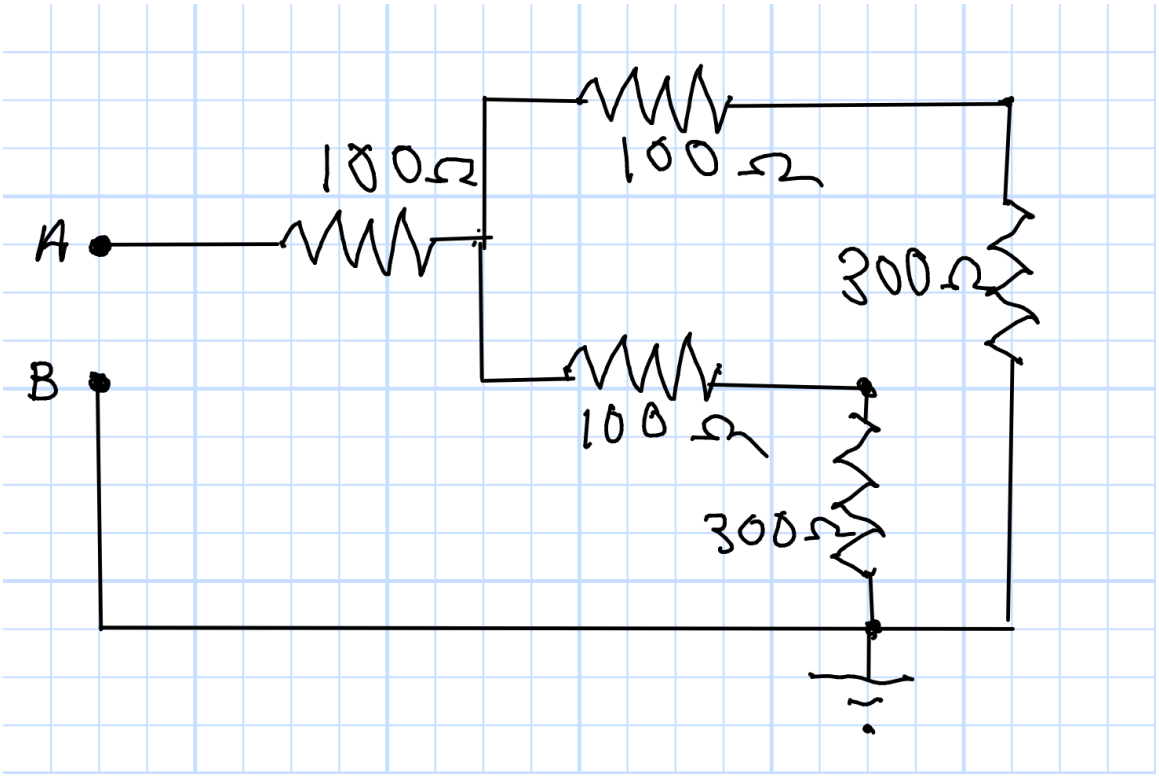
A good power amplifier has

☐ A large input impedance and small output impedance
☒ Input impedance matched to the source and output impedance matched to the load
☐ Small input and output impedance
☐ large input and output impedance

An operational amplifier responds instantaneously to a change in input.

☐ True ☒ False

2 Resistor Combinations: 25 Points



a. Calculate the resistance of this circuit as seen at the terminals A and B.

b. If a current of 10 mA is introduced by a source placed across terminals A and B, what is the current in each of the 300 Ohm resistors shown?

c. What power is consumed by one of the 300 Ohm resistors?

d. What power is produced by the source?

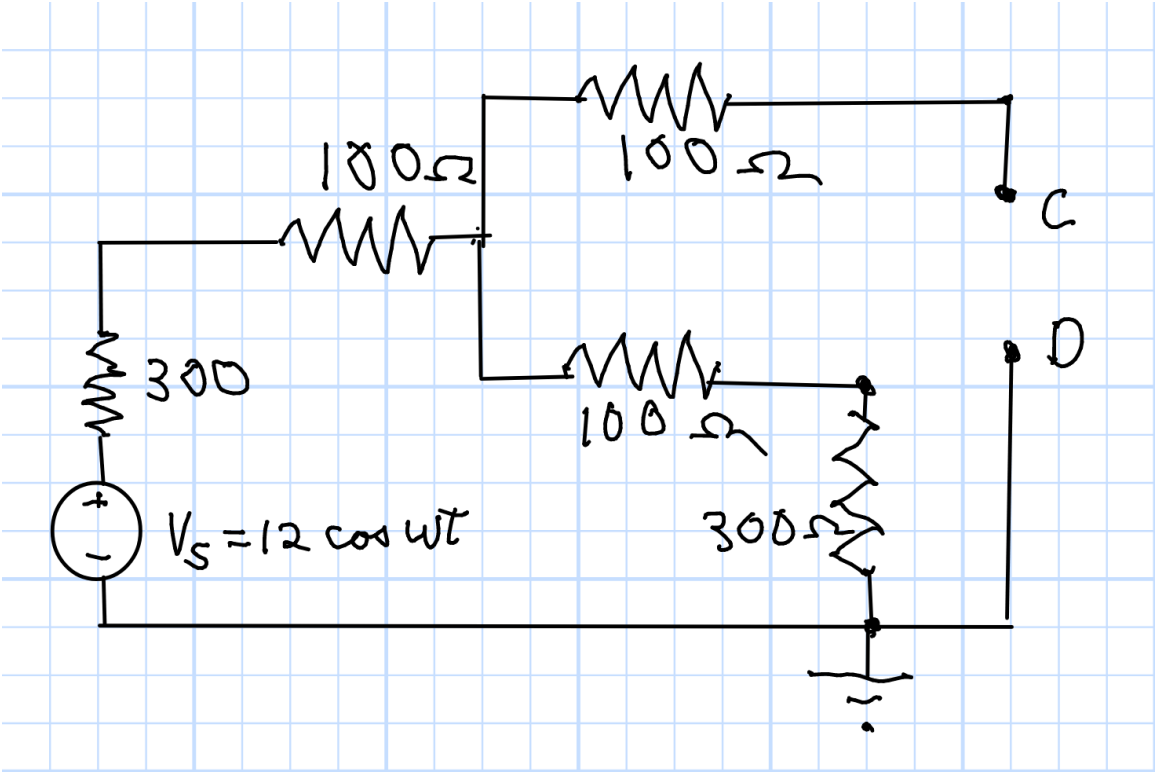
(a) $100 + (400 \| 400) = 300\ \Omega$

(b) current divider. 5 mA.

(c) $i^2R = (5\text{ mA})^2 \times 300\ \Omega = 7.5\text{ mW}$

(d) $i^2R = (10\text{ mA})^2 \times 300\ \Omega = 30\text{ mW}$

3 Thévenin Equivalent Circuit: 25 Points



a. What is the Thévenin equivalent circuit seen at terminals C and D?

b. If a 300 Ohm load is placed across terminals C and D, what is the voltage across that load?

c. What is the current in this load resistor?

d. What is the power in this load resistor?

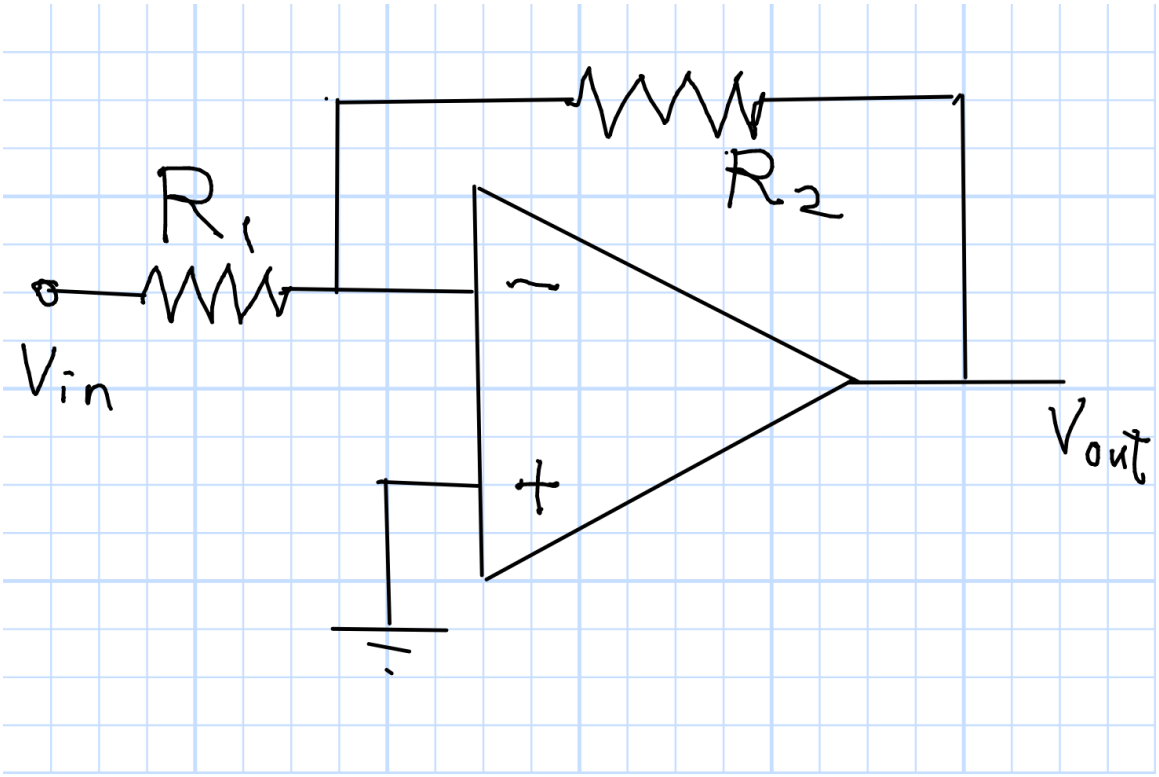
(a) $V_T \approx V_s \frac{400}{400+400} = 6 \cos \omega t$ $R_T = 300\Omega$ as in pr 2

(b) $V = V_T \frac{R_L}{R_L + R_T} \approx 3 \cos \omega t$

(c) $i \approx \frac{V}{R_L} = 10 \text{ mA} \cos \omega t$

(d) $P \approx i R = 30 \text{ mW} \cos^2 \omega t$

4 OpAmp: 25 Points



In the circuit shown, $R_1 = 4$ kOhm and $R_2 = 20$ kOhm.

a. What is the gain of this amplifier circuit?

b. If we attach a load resistor of 50 kOhms, what is the power gain?

c. If the power supplies are +12 Volts and −12 Volts, and the input voltage is $v_{in} = -3$ Volts will the amplifier be in saturation? What will be the voltage at the inverting input?

d. The op–amp has a gain–bandwidth product of 10 MHz. What is the highest frequency at which you could use this amplifier if you want the power to be reduced by less than a factor of two?

(a) $A_v = -\frac{R_2}{R_1} \simeq -5$

(b) $P_{out} = \frac{V_o^2}{R_L} = \frac{A^2 V_{in}^2}{R_L}$ $P_{in} = \frac{V_{in}^2}{R_1}$ $A_p = \frac{A_v^2 R_1}{R_L} = 2$

(c) yes: $v_- = v_{in} + (V_o - v_{in}) \frac{R_1}{R_1 + R_2} = -3 + 15 \times \frac{4}{24} = -0.5$ V

(d) $F_0 \simeq f_{BOC} A_{OL} / A_v = 10\text{MHz}/5 \simeq 2\text{MHz}$

5 Answersheet

Name: _____

5.1 Resistor Combinations

a. _____

b. _____

c. _____

d. _____

5.2 Thévenin Equivalent

a. _____

b. _____

c. _____

d. _____

5.3 OpAmp

a. _____

b. _____

c. _____

d. _____