EECS 210 – Final – 12/17/98
Closed book, no notes, calculators are allowed, 2 hours

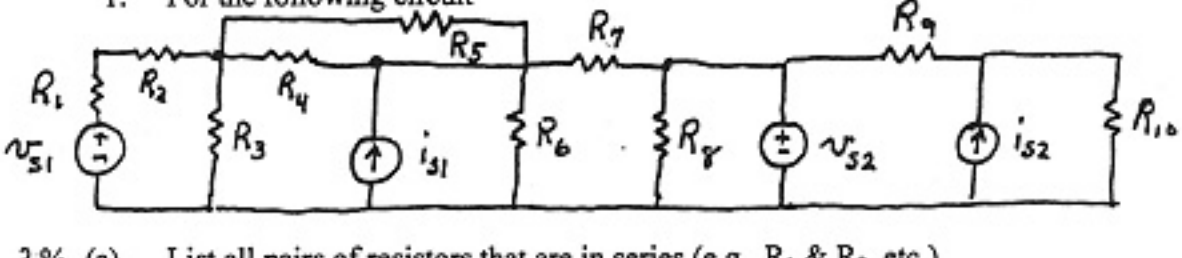
Name: _____ Lecture Section: 2

I have neither given nor received aid on this exam, nor have I concealed any violation of the Honor Code.

Signature: _____

Please present analyses and solutions to the following problems in your blue book. **Your final answers should be designated by drawing boxes around them. Please include your name and lecture section on the cover of the blue book.**

1. For the following circuit



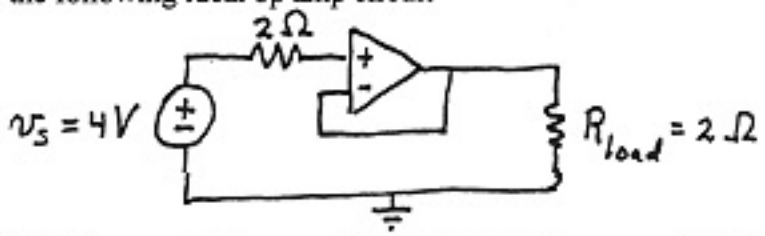
3 % (a) List all pairs of resistors that are in series (e.g., R_1 & R_2, etc.)

3 % (b) List all pairs of resistors that are in parallel

3 % (c) List all pairs consisting of a source and a resistor that can be considered to be in Norton form

3 % (d) List all pairs consisting of a source and a resistor that can be considered to be in Thevenin form

2. For the following ideal op amp circuit

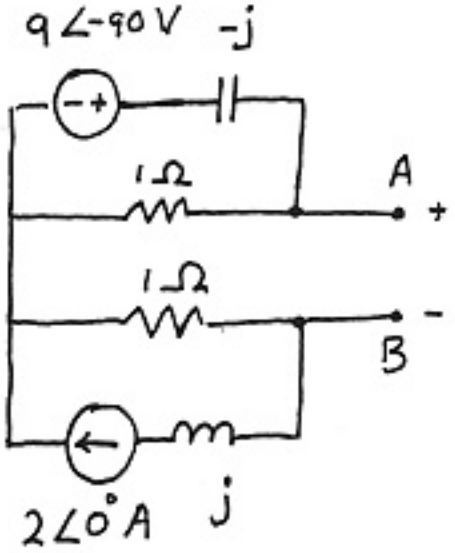


4% (a) What is the power being supplied by the source (in watts)?

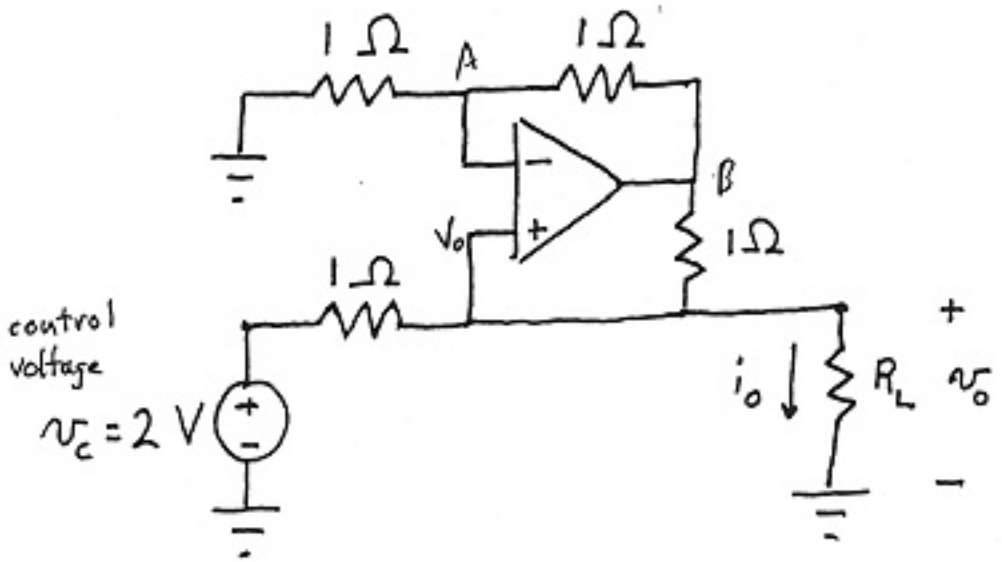
4% (b) What is the power being supplied by the op amp (in watts)?

5 % 3. A 2 ohm resistor is in parallel with a 1/4 F capacitor. The voltage across the pair is $v(t) = 4 \sin(2t)$ V. What is the average dissipated power (in watts)?

20 % 4. Replace the circuit between A and B with the phasor form of its Thevenin equivalent circuit. Show the amplitude and phase angle of the Thevenin equivalent voltage, $\underline{V}_T$, and the amplitude and phase angle of the source impedance, Z_T?



20 % 5. The following circuit is an example of a voltage controlled current source. Within the linear range of the op amp, you will find that the output current is independent of the choice of load resistance R_L. What is the current i_o for a control voltage of 2 V (in amps)?



6. A signal x(t) can be represented by the following sum

$$x(t) = 3 + \sum_{n=1}^{\infty} \frac{1}{n^2} \cos(2000\pi nt)$$

4% (a) What is the period of this signal?

4% (b) What is the dc value of this signal?

When the signal x(t) is the input to a certain filter, the output of the filter is

$$y(t) = 5 + 3\cos(2000\pi t) + \frac{1}{90}\cos(6000\pi t + 60°)$$

6% (c) What are the gain and the phase shift of the frequency response of this filter at frequency 3 kHz?

6% (d) Find the output y(t) of this filter when the input signal is

$$x(t) = \sin(2000\pi t) + 4\cos(4000\pi t) + 6\sin(6000\pi t + 45°)$$

7. Given $H(j\omega) = \frac{j\omega}{j\omega + 1} \frac{2}{j\omega + 2}$

5% (a) What kind of filter has this frequency response (low pass, high pass, band pass, notch)?

10%(b) Design a filter with this frequency response.

EECS 210 – Final – 12/21/98
Closed book, no notes, calculators are allowed, 2 hours

Name: _____ Lecture Section: 1

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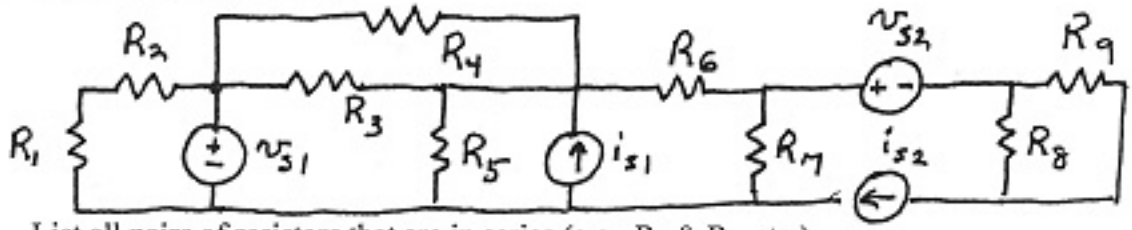
Signature: _____

Please present analyses and solutions to the following problems in your blue book. **Your final answers should be designated by drawing boxes around them. Please include your name and lecture section on the cover of the blue book.** Do not worry that your exam sheet and blue book might become separated.

1. For the following circuit



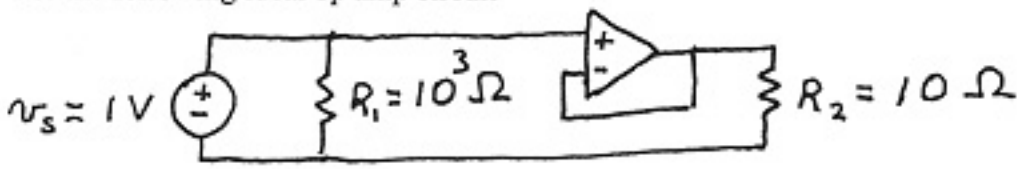
3% (a) List all pairs of resistors that are in series (e.g., R_1 & R_2, etc.)

3% (b) List all pairs of resistors that are in parallel

3% (c) List all combinations consisting of a source and one or more resistors that can be considered to be in Norton form

3% (d) List all combinations consisting of a source and one or more resistors that can be considered to be in Thevenin form

2. For the following ideal op amp circuit

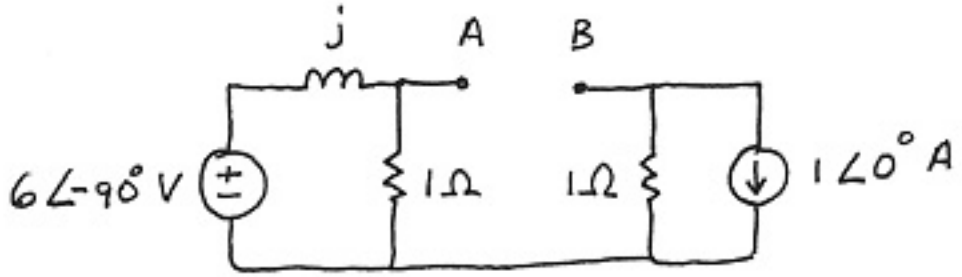


4% (a) What is the power being supplied by the source v_s (in watts)?

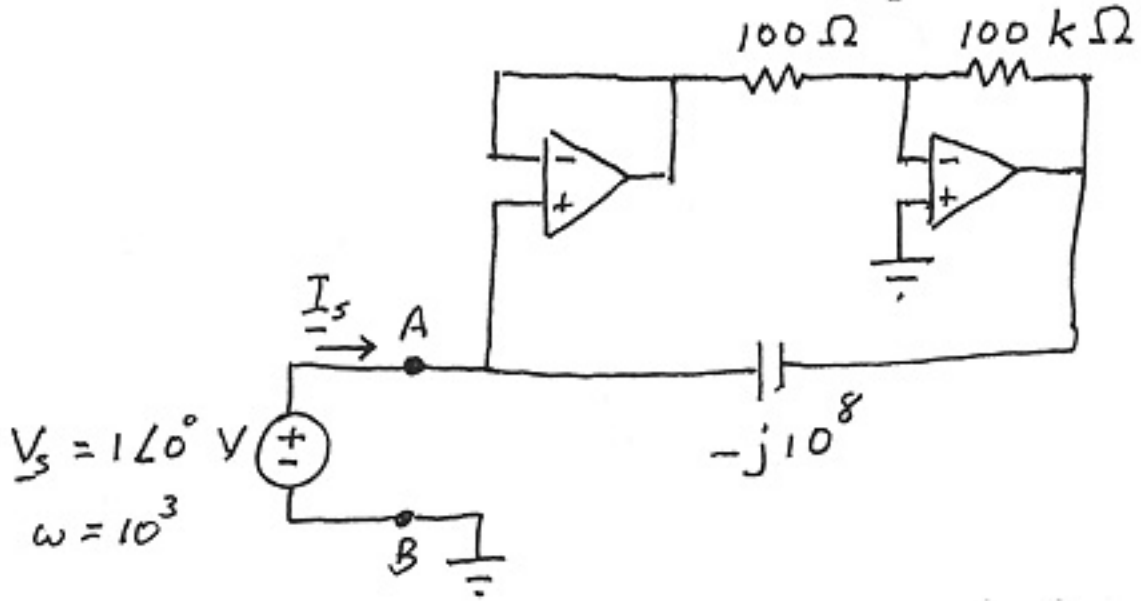
4% (b) What is the power being supplied by the op amp (in watts)?

5% 3. A 2 ohm resistor is in series with a 1/4 F capacitor. The current through the pair is $i(t) = 4 \sin(2t)$ A. What is the average dissipated power (in watts)?

20% 4. Replace the circuit between A and B with the phasor form of its Thevenin equivalent circuit. Show the amplitude and phase angle of the Thevenin equivalent voltage, $\underline{V}_T$, and the amplitude and phase angle of the source impedance, Z_T?



20% 5. The following circuit acts as a capacitance multiplier. The effective impedance between terminals A and B looks like that of a capacitor that is larger than the capacitor in the circuit. For a voltage source, $\underline{V}_s = 1\angle 0°$, placed across terminals A and B as shown, what is the effective impedance, $Z_{eff} = \underline{V}_s/\underline{I}_s$ (in ohms)?



6. A signal x(t) can be represented by the following sum

$$x(t) = 5 + \sum_{n=1}^{\infty} \frac{1}{n^3} \cos(1000\pi nt)$$

4% (a) What is the period of this signal?

4% (b) What is the dc value of this signal?

When the signal x(t) is the input to a certain filter, the output of the filter is

$$y(t) = \frac{1}{6}\cos(1000\pi t + 30^\circ) + \frac{1}{54}\cos(3000\pi t - 30^\circ)$$

6% (c) What are the gain and the phase shift of the frequency response of this filter at frequency 1.5 kHz?

6% (d) Find the output y(t) of this filter when the input signal is

$$x(t) = 5 + \sum_{n=1}^{\infty} \frac{1}{n} \sin(1000\pi nt)$$

7. Given $H(j\omega) = \left(\frac{2}{2 + j\omega}\right)^3$

5% (a) What kind of filter has this frequency response (low pass, high pass, band pass, notch)?

10%(b) Design a filter with this frequency response.