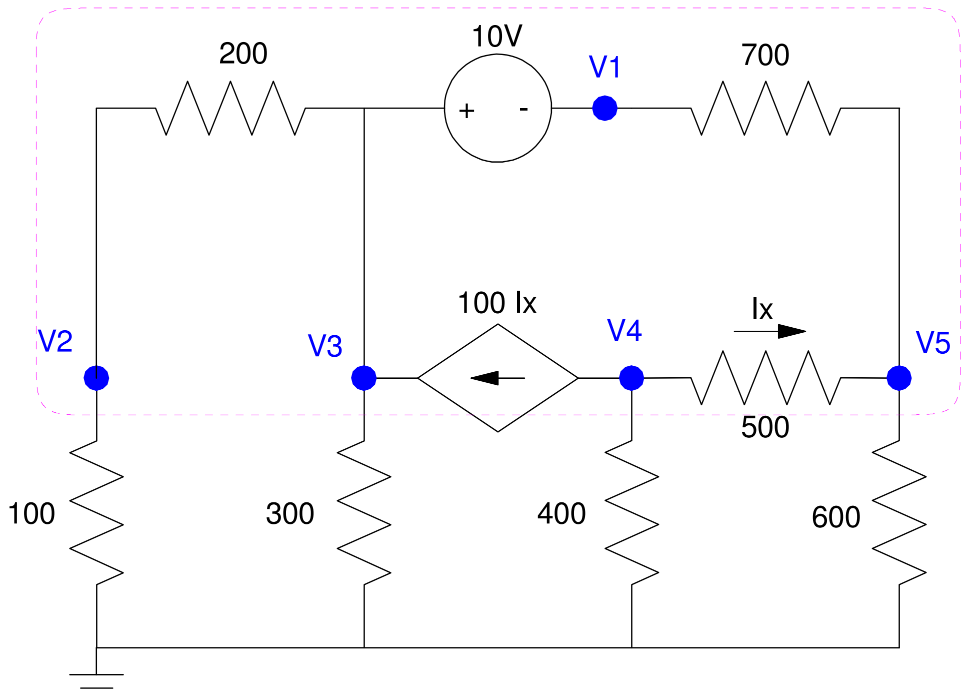
EE 206 Final - Name ____________________

Open Book, Open Notes, Open Internet. Matlab and CircuitLab (or equivalent) recommended

Individual Effort: Due May 8th at midnight. (Please email results to Jacob_Glower@yahoo.com)

No Aid Given, Received, or Observerd (please sign if you didn't get help from someone else) ______________________________

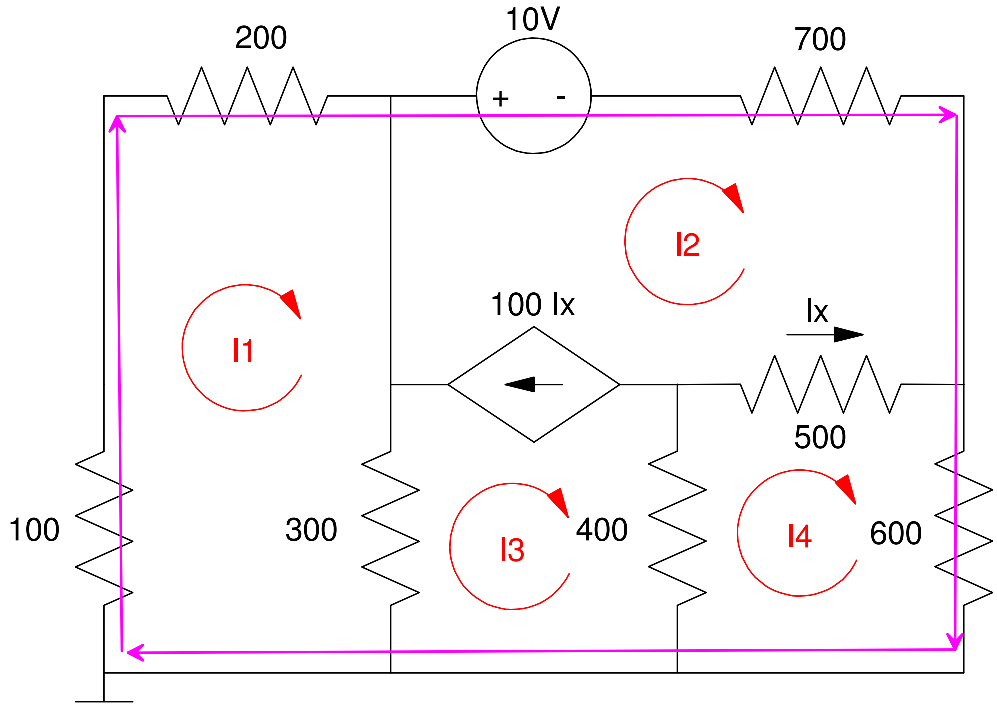
1) Write the voltage node equations for the following circuit.



5 nodes plus a dependent source means you need 6 equations for 6 unknowns

- $I_x = \left(\frac{V_4 - V_4}{500}\right)$
- $V_3 - V_1 = 10$
- $\left(\frac{V_2}{100}\right) + \left(\frac{V_2 - V_3}{200}\right) = 0$
- $100 I_x + \left(\frac{V_4}{400}\right) + \left(\frac{V_4 - V_5}{500}\right) = 0$
- $\left(\frac{V_5 - V_4}{500}\right) + \left(\frac{V_5}{800}\right) + \left(\frac{V_5 - V_1}{700}\right) = 0$
- $\left(\frac{V_2}{100}\right) + \left(\frac{V_3}{300}\right) + \left(\frac{V_4}{400}\right) + \left(\frac{V_5}{600}\right)$

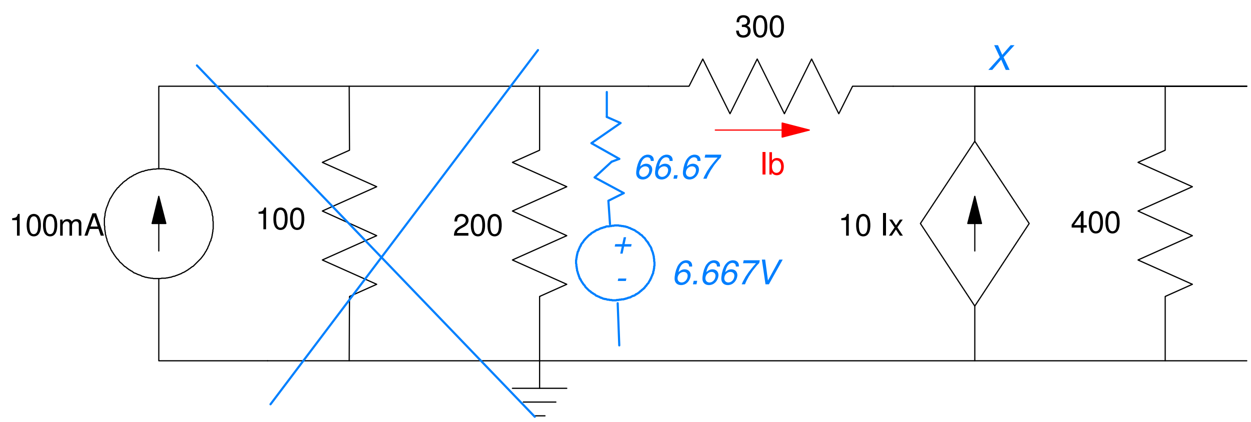
2) Write the current loop equations for the following circuit



- $I_x = I_4 - I_2$
- $100I_x = I_2 - I_3$
- $100I_1 + 200I_1 + 300(I_1 - I_3) = 0$
- $400(I_4 - I_3) + 500(I_4 - I_2) + 600I_4 = 0$
- $100I_1 + 200I_1 + 10 + 700II_2 + 600I_4 = 0$

3) Determine the Thevenin equivalent for the following circuit

Vth	Rth
6.154 V	**30.77 Ohms**



100 || 200 = 66.67 Ohms

Convert the 100mA and 66.67 Ohm to a Thevenin

Vth = 6.6667V

Rth = 66.667 Ohms

Vth

$$\left(\frac{X-6.6667}{366.67}\right)+10\left(\frac{X-6.6667}{366.67}\right)+\left(\frac{X}{400}\right)=0$$

$X = 6.154V$ = Vth

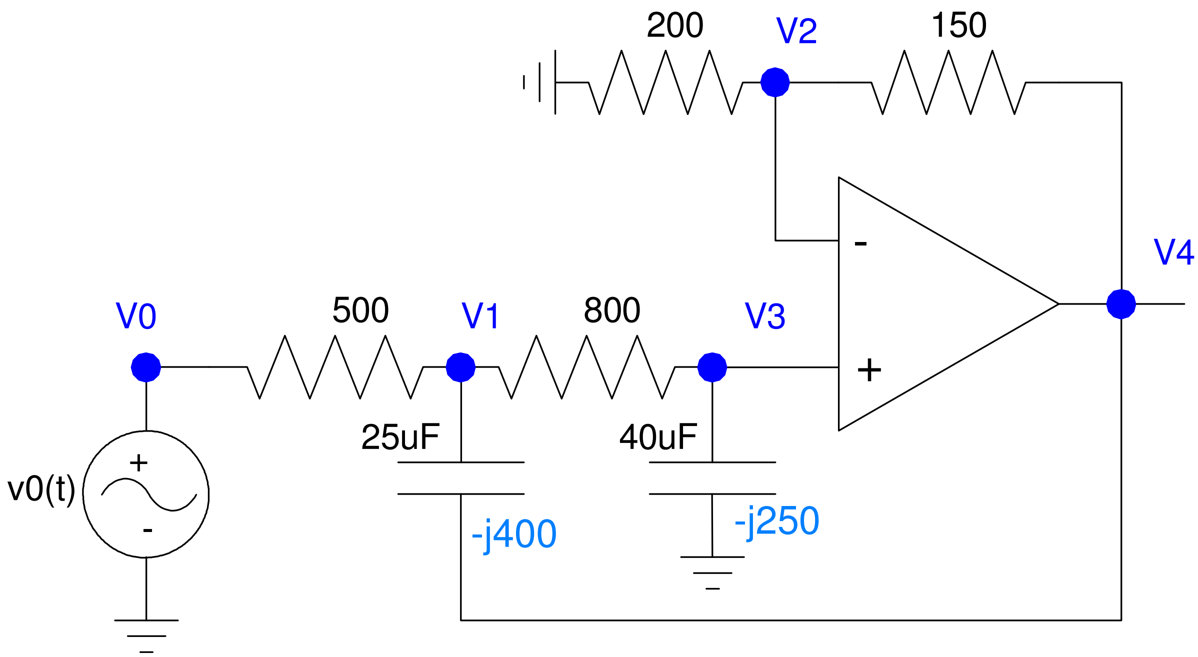
Rth: Turn off the sources. Apply a 1V source at the output. Determine the current

$$I=\left(\frac{1}{400}\right)+\left(\frac{1}{366.67}\right)+10\left(\frac{1}{366.67}\right)=32.50mA$$

$$R_{th}=\frac{1V}{32.50mA}=30.77\Omega$$

4) Write the voltage node equations for the following op-amp circuit. Assume

$$v_0(t) = 3\cos(100t) + 4\sin(100t)$$

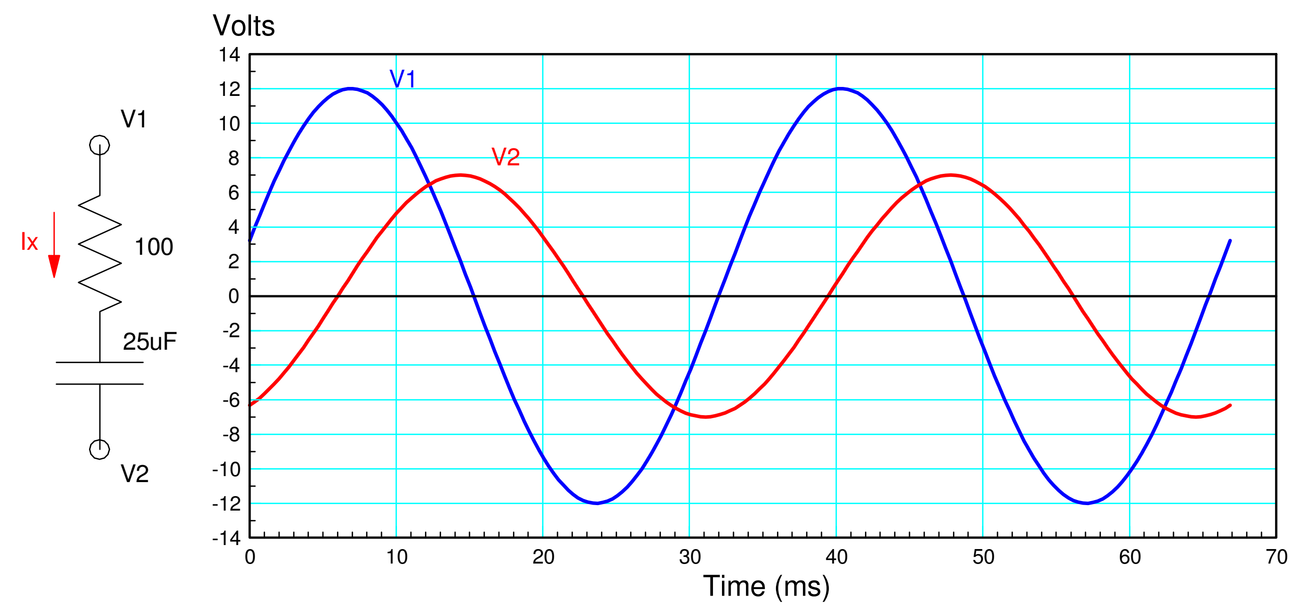


- $V_0 = 3 - j4$
- $V_2 = V_3$
- $\left(\frac{V_1 - V_0}{500}\right) + \left(\frac{V_1 - V_4}{-j400}\right) + \left(\frac{V_1 - V_3}{800}\right) = 0$
- $\left(\frac{V_3 - V_1}{800}\right) + \left(\frac{V_3}{-j250}\right) = 0$
- $\left(\frac{V_2}{200}\right) + \left(\frac{V_2 - V_4}{150}\right) = 0$

5) Phasors: The voltages at V1 and V2 are shown below. Determine

- The phasor representation of these two voltages, and
- The phasor representation for the current, Ix

Frequency Hz	V1 phasor form	V2 phasor form	Current Ix phasor form
30.30 Hz	$12\angle -64.5^0$	$7\angle -152.7^0$	$(-8.541 - j58.26)mA$



Period = 33ms

$$f = \frac{1}{period} = \frac{1}{33ms} = 30.30Hz$$

$$\phi_1 = -\left(\frac{6ms}{33ms}\right)360^0 = -64.5^0$$

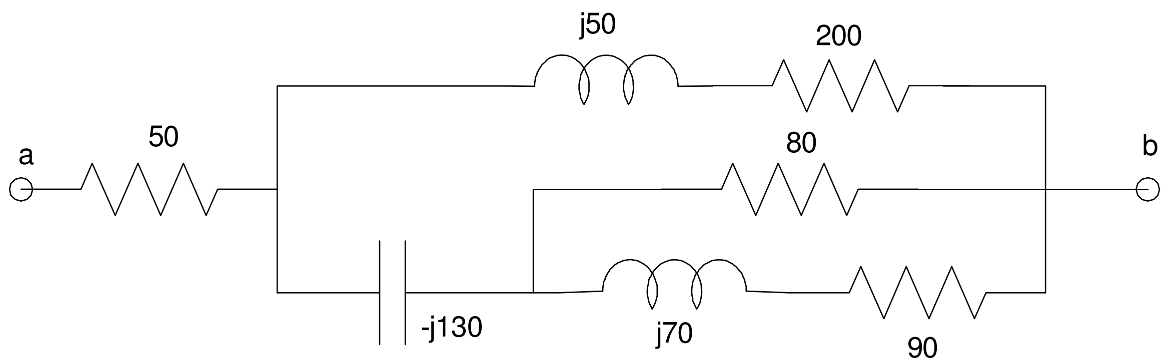
$$\phi_2 = -\left(\frac{14ms}{33ms}\right)360^0 = -152.7^0$$

$$C \rightarrow \frac{1}{j\omega C} = \frac{1}{j\cdot 2\pi\cdot 30.30\cdot 25\mu F} = -j210.1\Omega$$

$$I_x = \left(\frac{\left(12\angle -64.5^0\right) - \left(7\angle -152.7^0\right)}{100 - j210.1}\right) = (-8.541 - j58.26)mA = (58.88\angle -98.34)mA$$

6) Determine the impedance: Zab

Zab = 129.177 - j63.249



$90 + j70 \parallel 80 = 47.811 + j13.254$

$(47.811 + j13.254) + (-j130) = 47.811 - j116.746$

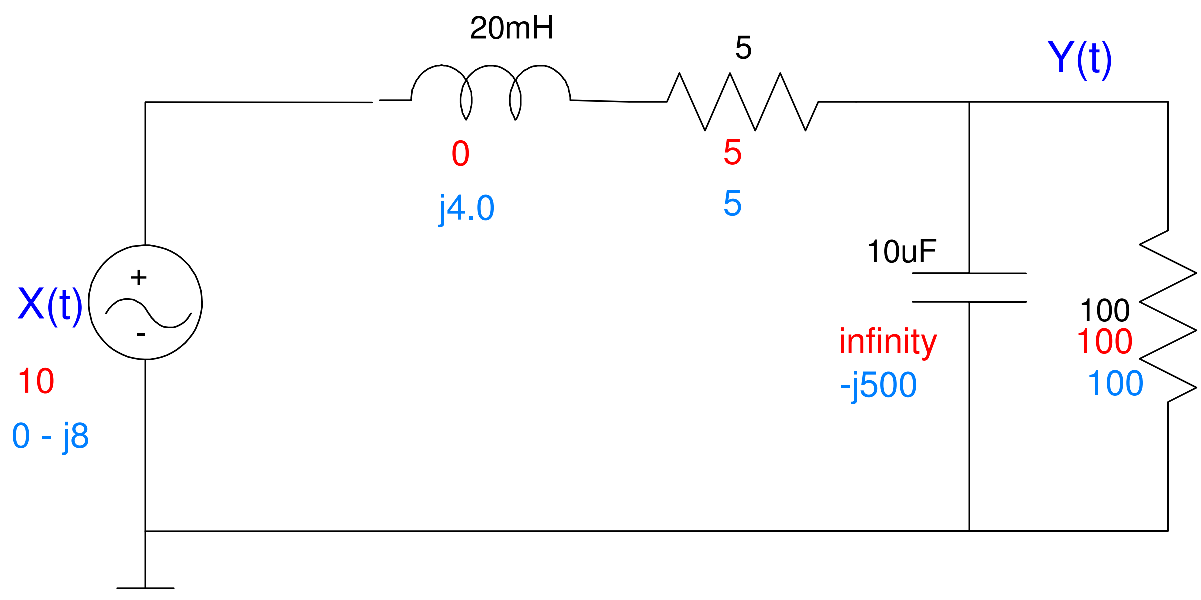
$(47.811 - j116.746) \parallel (200 + j50) = 79.177 - j63.249$

$(79.177 - j63.249) + 50 = 129.177 - j63.249$

7) Determine y(t) assuming

$$x(t) = 10 + 8\sin(200t)$$

y(t) = 9.524 - 0.368 cos(200t) + 7.66 sin(200t)



DC (red)

$$Y = \left(\frac{100}{100+5}\right)10$$

$$Y = 9.524$$

AC (blue)

$$100 \,||\, -j500 = 96.154 - j19.231$$

$$Y = \left(\frac{(96.154 - j19.231)}{(96.154 - j19.231) + (5 + j4)}\right)(0 - j8)$$

$$Y = -0.368 - j7.660$$

$$y(t) = -0.368\cos(200t) + 7.660\sin(200t)$$

Bonus!

(If you would like to remain anonymous, please send your response to Anne Campbell and then just note this on your final exam)

Having the unique experience of taking EE 206 both in-person and on-line in the same semester, I'm interested in your opinions.

i) It's very possible that many ECE classes will be available for on-line instruction next fall. If on-line classes were offered (meaning you don't need to even be in Fargo), what is the chance you would take the on-line version?

0 1 2 3 4 5 6 7 8 9 10
Not a chance highly likely

ii) Please give an example of something done well with the on-line instruction for EE 206

iii) Please give an example of something that needs improving with this class

Have a nice summer!