EE 206 Test #3d - Name _____

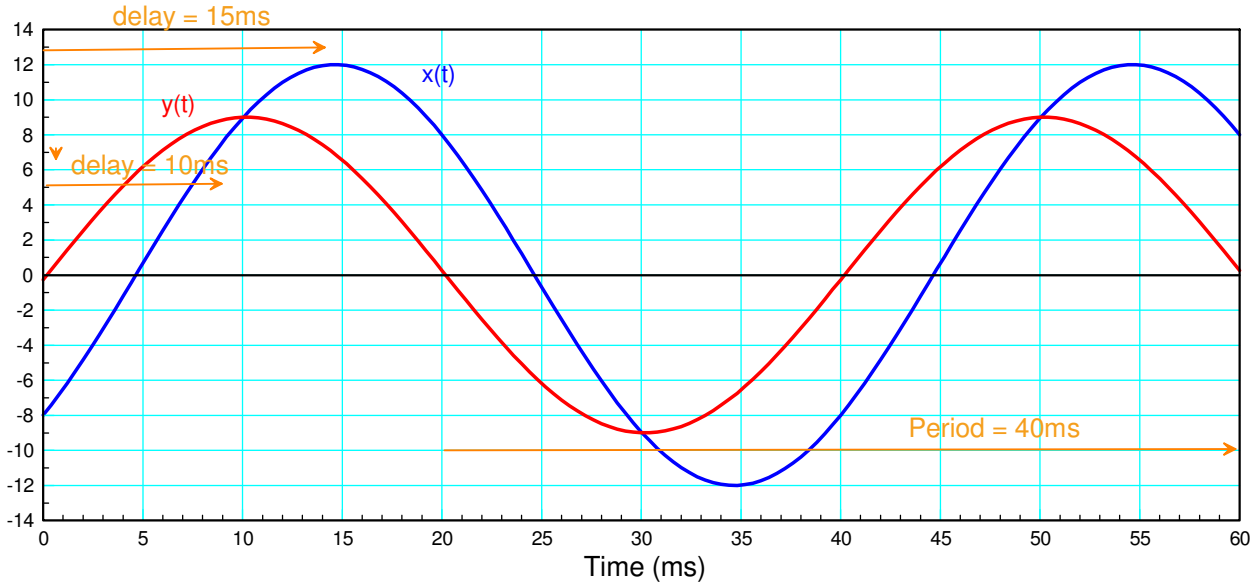
AC Analysis of Circuits. Due Thursday, May 7th at midnight

Open book, open notes, internet, calculators, matlab permitted. Individual effort only.

No aid given, received, or observed: (signature) _____

1) Determine the frequency and the phasor represetation for X and Y.

Frequency (Hz)	X		Y	
	Amplitude	Phase	Amplitude	Phase
25 Hz	**12V**	**-135 deg**	**9V**	**-90 deg**



$T = period = 40ms$

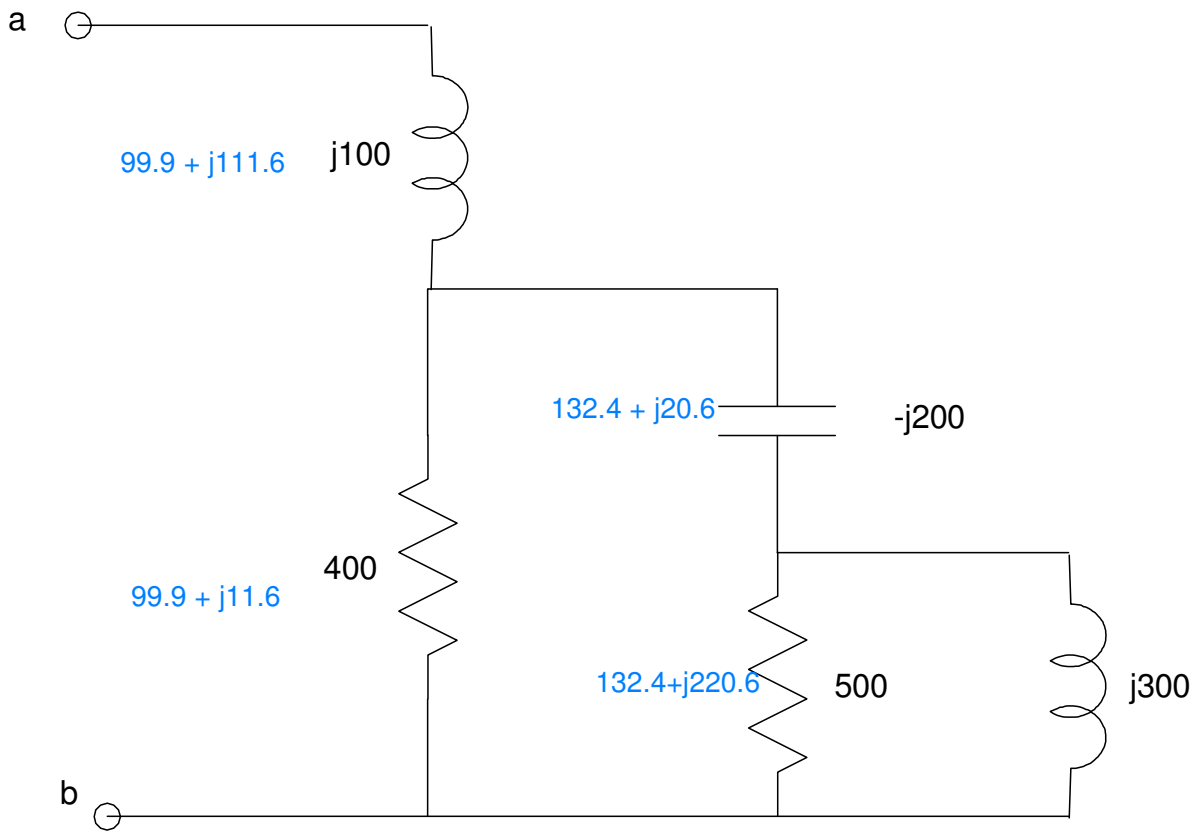
$f = \frac{1}{T} = 25Hz$

$\theta_x = -\left(\frac{15ms}{40ms}\right) 360^0 = -135^0$

$\theta_y = -\left(\frac{10ms}{40ms}\right) 360^0 = -90^0$

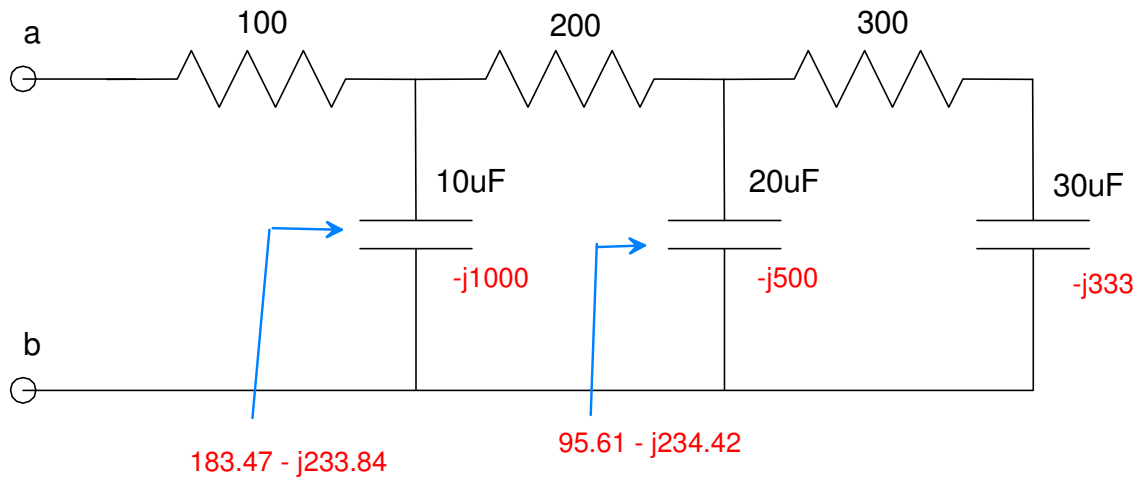
2) Determine the resistace Rab (it will be a complex number)

99.9 + j111.6 Ohms



3) Determine the impedance from a to b. Assume w = 100 rad/sec (15.9Hz)

283.47 - j233.84

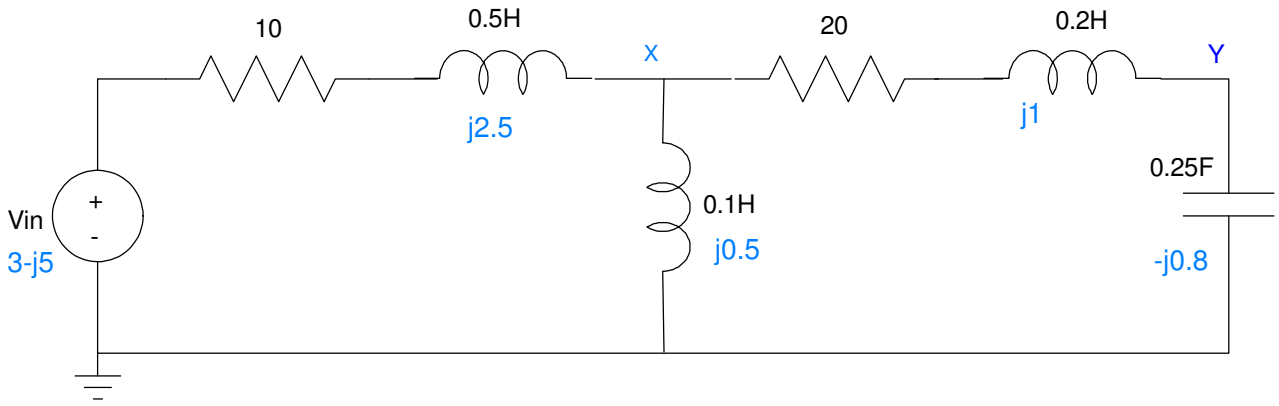


4) Assume

$$V_{in} = 3\cos(5t) + 5\sin(5t)$$

Determine the voltage Y(t)

y(t) = -0.0024 cos(5t) - 0.0109 sin(5t)



$$\left(\frac{X-Y}{20+j}\right) + \left(\frac{X}{j0.5}\right) + \left(\frac{X-(3-j5)}{10+j2.5}\right) = 0$$

$$\left(\frac{Y-X}{20+j}\right) + \left(\frac{Y}{-j0.8}\right) - 0$$

Group terms, place in matrix form

$$\begin{bmatrix} \left(\frac{1}{10+j2.5} + \frac{1}{j0.5} + \frac{1}{20+j}\right) & \left(\frac{1}{20+j}\right) \\ \left(\frac{1}{20+j}\right) & \left(\frac{1}{20+j} + \frac{1}{-j0.8}\right) \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} \left(\frac{1}{10+j2.5}\right) \\ 0 \end{bmatrix} (3-j5)$$

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A = [1/(10+j*2.5)+1/(j*0.5)+1/(20+j), 1/(20+j) ; 1/(20+j),1/(20+j)+1/(-j*0.8)]

   0.1440 - 2.0260i   0.0499 - 0.0025i
   0.0499 - 0.0025i   0.0499 + 1.2475i

B = [1/(10+j*2.5) ; 0]

   0.0941 - 0.0235i
        0

V = inv(A)*B*(3 - j*5)

x   0.2718 + 0.0620i
y  -0.0024 + 0.0109i
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5) Assume

$$V_{in} = 3\cos(5t) + 7\sin(10t)$$

Determine the voltage y(t)

y(t) = -0.0054 cos(5t) - 0.0018 sin(5t)

+ 0.0073 cos(10t) - j0.0093 sin(10t)

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y  -0.0054 + 0.0018i
y   0.0073 + 0.0093i
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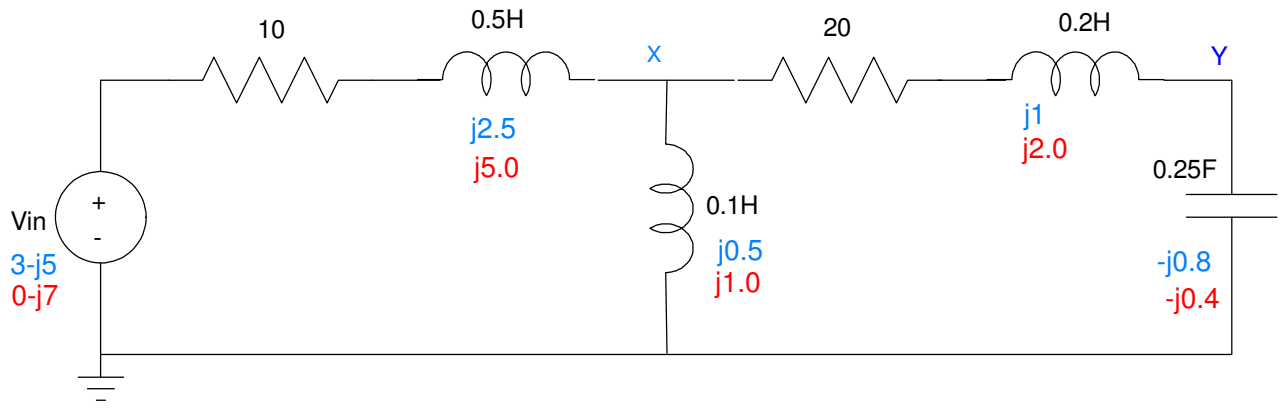
Start with

x(t) = 3 cos(5t)

X = 3 + j0

This is the same problem as #4 with a different input (3 + j0)



At 5 rad/sec (blue: input is 3 + j0)

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A = [1/(10+j*2.5)+1/(j*0.5)+1/(20+j), 1/(20+j) ; 1/(20+j),1/(20+j)+1/(-j*0.8)]

B = [1/(10+j*2.5) ; 0]

V = inv(A)*B*(3 - j*0)

x   0.0446 + 0.1363i
y  -0.0054 + 0.0018i
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Repeat at 10 rad/sec (red)

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A = [1/(10+j*5)+1/(j*1)+1/(20+j*2), 1/(20+j*2) ; 1/(20+j*2),1/(20+j*2)+1/(-j*0.4)]

B = [1/(10+j*5) ; 0]

V = inv(A)*B*(0 - j*7)

x   0.4955 - 0.3298i
y   0.0073 + 0.0093i
```

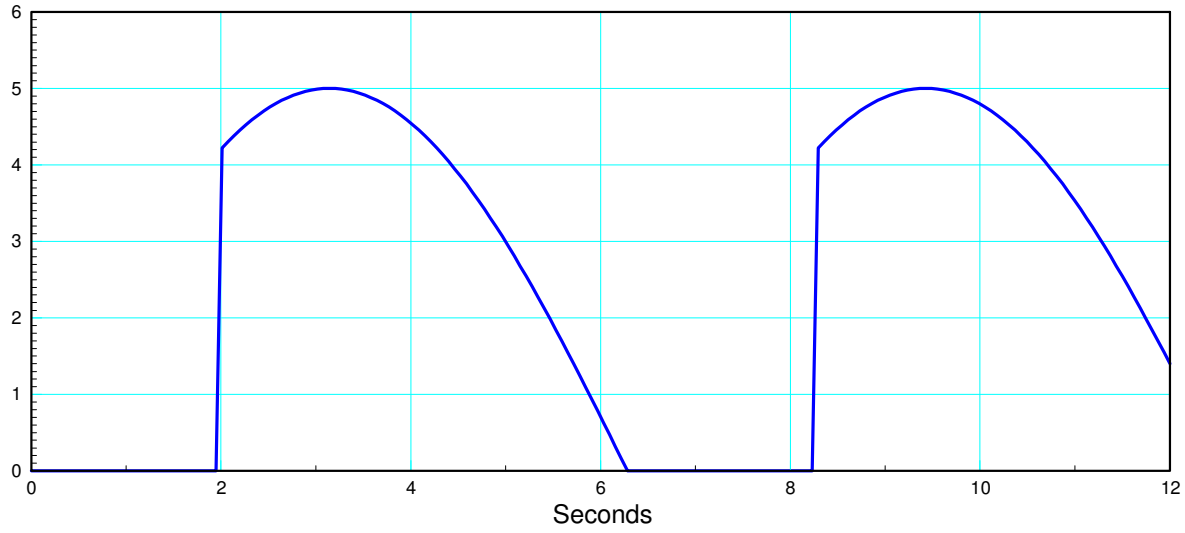
6) Determine the first 5 terms of the Fourier series approximation to x(t)

$$T = 2\pi$$

$$x(t) = \begin{cases} 0 & 0 < t < 2 \\ 5\sin(t/2) & 2 < t < 2\pi \end{cases}$$

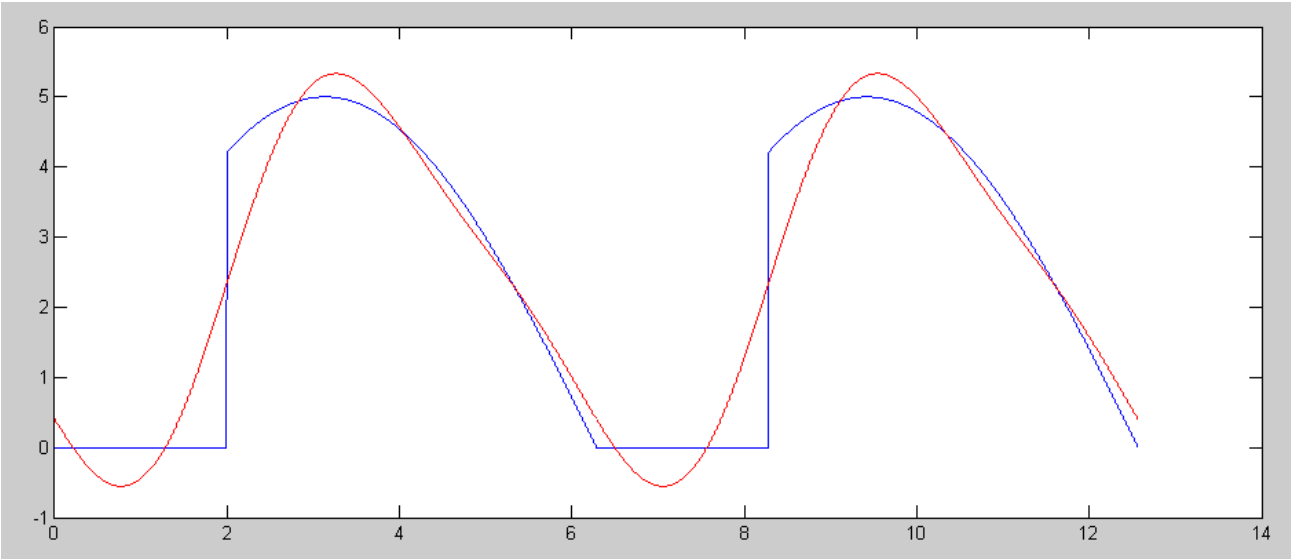
$$x(t) \approx a_0 + a_1\cos(t) + b_1\sin(t) + a_2\cos(2t) + b_2\sin(2t)$$

a0	a1	b1	a2	b2
2.4515	**-2.4462**	**-1.2643**	**0.4033**	**-0.3801**




```
t = [0:0.00001:1]' * 2 * pi;
x = 5*sin(t/2) .* (t>2);
plot(t,x)
a0 = mean(x)
a0 =    2.4515
a1 = 2*mean(x .* cos(t))
a1 =   -2.4462
b1 = 2*mean(x .* sin(t))
b1 =  -1.2643
a2 = 2*mean(x .* cos(2*t))
a2 =   0.4033
b2 = 2*mean(x .* sin(2*t))
b2 =  -0.3801

y = a0 + a1*cos(t) + b1*sin(t) + a2*cos(2*t) + b2*sin(2*t);
plot(t,x,,'b',t,y,'r')
```


6
5
4
3
2
1
0
-1
0
2
4
6
8
10
12
14