EE 206 Test #3 - Name _____

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

Frequency (Hz)	X		Y	
	Amplitude	Phase	Amplitude	Phase
33.33 Hz	**13V**	**-60 deg**	**9V**	**-24 deg**
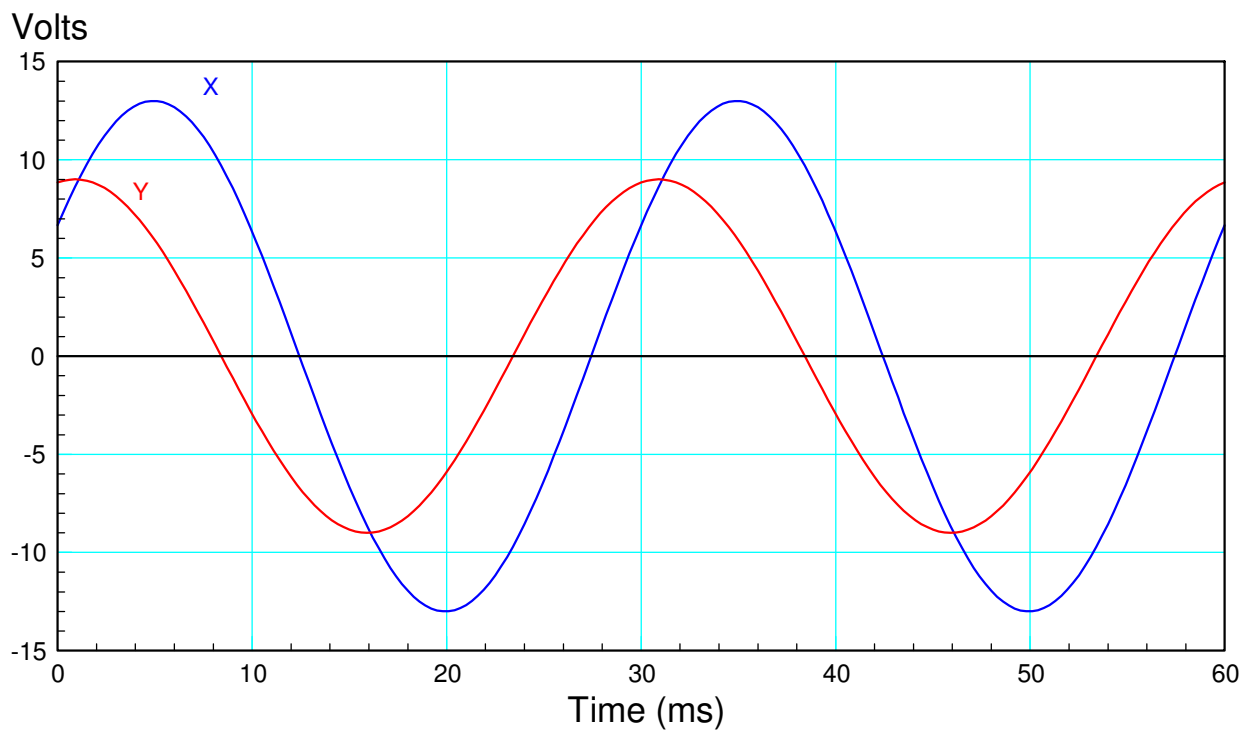
2) Determine the resistace Rab (it will be a complex number)

Rab = 94.228 - j8.358
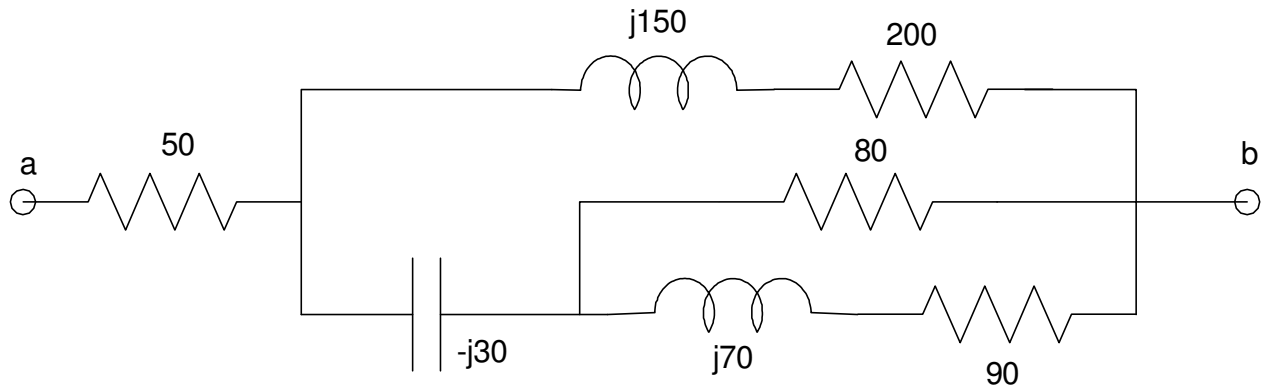
$90 + j70 \parallel 80 = 47.811 + j13.254$
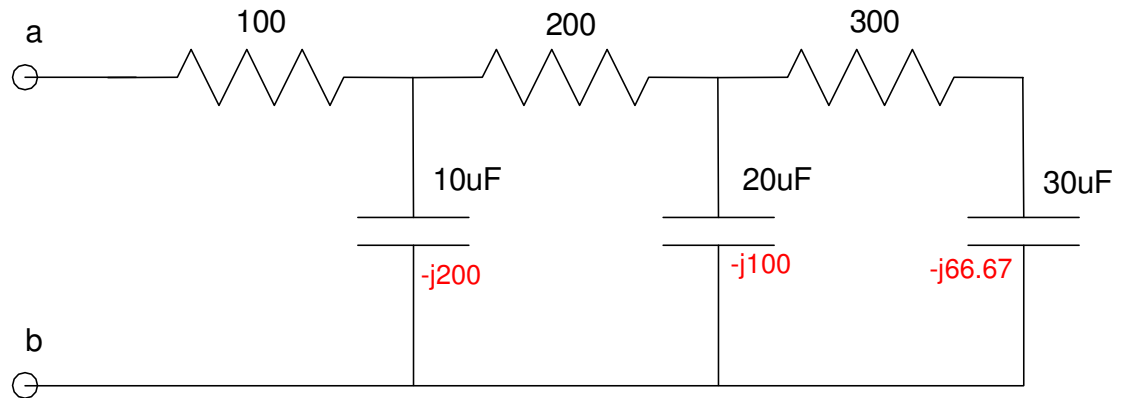
$47.811 + j13.254 + (-j30) = 47.811 - j16.746$

$(47.811 - j16.746) \parallel (200 + j150) = 44.228 - j8.358$

$(44.228 - j8.358) + 50 = 94.228 - j8.358$

3) Determine the impedance from a to b. Assume w = 500 rad/sec (79.58Hz)

Zab = 168.043 - j113.737

(300 - j66.67) || (-j100) = 25.472 - j85.849

(25.472 - j85.849) + 200 = 225.472 - j85.849

(225.472 - j85.849) || (-j200) = 68.043 - j113.737
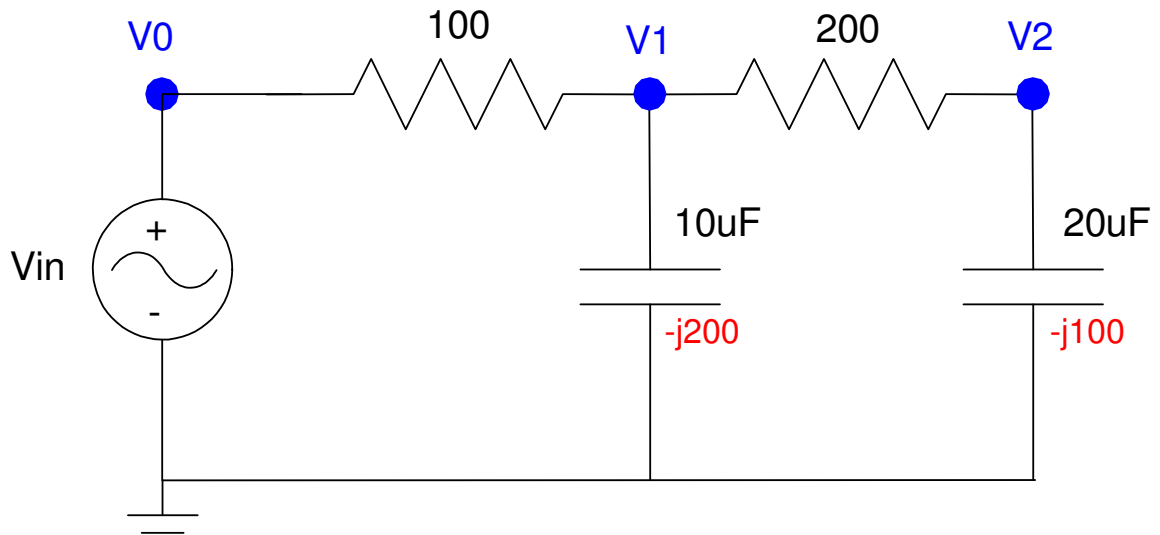
(68.043 - j113.737) + 100 = 168.043 - j113.737

4) Assume
$$V_{in} = 10\cos(500t) + 20\sin(500t)$$

Determine the voltages v1(t) and v2(t)

v1(t) = 0 cos(500t) + 14.2857 sin(500t)
v2(t) = 5.7143 cos(500t) + 2.8571 sin(500t)

Several approaches. Since I have access to Matlab, use voltage nodes:

$$V_0 = 10 - j20$$

$$\left(\frac{V_1 - V_0}{100}\right) + \left(\frac{V_1}{-j200}\right) + \left(\frac{V_1 - V_2}{200}\right) = 0$$

$$\left(\frac{V_2 - V_1}{200}\right) + \left(\frac{V_2}{-j100}\right) = 0$$

Place in matrix form

$$\begin{bmatrix} 1 & 0 & 0 \\ \left(\frac{-1}{100}\right) & \left(\frac{1}{100} + \frac{1}{-j200} + \frac{1}{200}\right) & \left(\frac{-1}{200}\right) \\ 0 & \left(\frac{-1}{200}\right) & \left(\frac{1}{200} + \frac{1}{-j100}\right) \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 10 - j20 \\ 0 \\ 0 \end{bmatrix}$$

```
>> A = [1,0,0;-1/100,1/100+1/(-j*200)+1/200,-1/200 ; 0,-1/200,1/200+1/(-j*100)]

A =

   1.0000                     0                     0
  -0.0100       0.0150 + 0.0050i   -0.0050
        0            -0.0050       0.0050 + 0.0100i

>> B = [10-j*20;0;0];
>> V = inv(A)*B

V =

  10.0000 -20.0000i
        0 -14.2857i
  -5.7143 -  2.8571i

>>
```
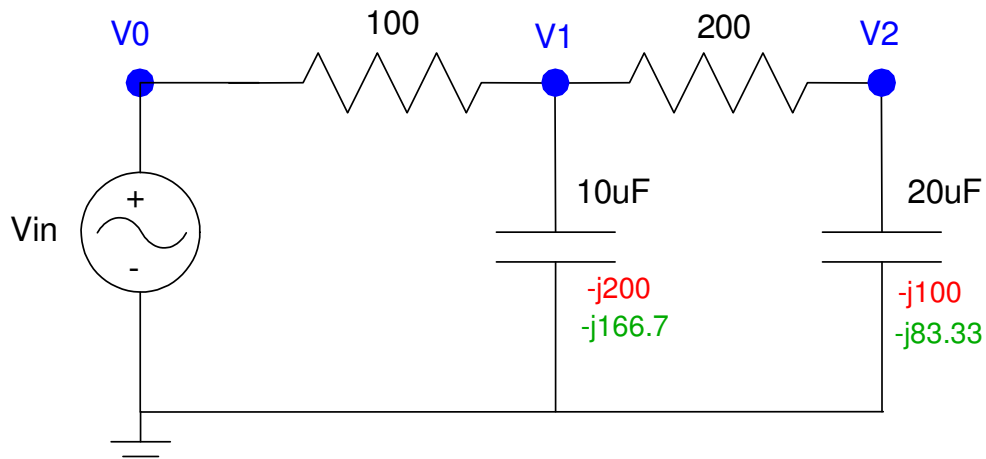
5) Assume

$$V_{in} = 10\cos(500t) + 11\sin(600t)$$

Determine the voltages v1(t) and v2(t)

V1(t) = 5.7143 cos(500t) + 2.8571 sin(500t)
- 3.2419 cos(600t) + 5.9461 sin(600t)
V2(t) = 2.8571 sin(600t)
- 2.5905 cos(600t) - 0.2714 sin(600t)

At w = 500 (red)

$$V_0 = 10 + j0$$

$$\left(\frac{V_1 - V_0}{100}\right) + \left(\frac{V_1}{-j200}\right) + \left(\frac{V_1 - V_2}{200}\right) = 0$$

$$\left(\frac{V_2 - V_1}{200}\right) + \left(\frac{V_2}{-j100}\right) = 0$$

Place in matrix form

$$\begin{bmatrix} 1 & 0 & 0 \\ \left(\frac{-1}{100}\right) & \left(\frac{1}{100} + \frac{1}{-j200} + \frac{1}{200}\right) & \left(\frac{-1}{200}\right) \\ 0 & \left(\frac{-1}{200}\right) & \left(\frac{1}{200} + \frac{1}{-j100}\right) \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 10 + j0 \\ 0 \\ 0 \end{bmatrix}$$

Solve

```
A = [1,0,0;-1/100,1/100+1/(-j*200)+1/200,-1/200 ; 0,-1/200,1/200+1/(-j*100)];
B = [10;0;0];
V = inv(A)*B
```

```
   10.0000
    5.7143 -  2.8571i
   -0.0000 -  2.8571i
```

At w = 600 (green)

$$V_0 = 0 - j11$$ note: Vo = 11 sin(600t)

$$\left(\frac{V_1-V_0}{100}\right) + \left(\frac{V_1}{-j166.67}\right) + \left(\frac{V_1-V_2}{200}\right) = 0$$

$$\left(\frac{V_2-V_1}{200}\right) + \left(\frac{V_2}{-j83.33}\right) = 0$$

Place in matrix form

$$\begin{bmatrix} 1 & 0 & 0 \\ \left(\frac{-1}{100}\right) & \left(\frac{1}{100}+\frac{1}{-j166.67}+\frac{1}{200}\right) & \left(\frac{-1}{200}\right) \\ 0 & \left(\frac{-1}{200}\right) & \left(\frac{1}{200}+\frac{1}{-j83.33}\right) \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 0-j11 \\ 0 \\ 0 \end{bmatrix}$$

```
A = [1,0,0;-1/100,1/100+1/(-j*166.67)+1/200,-1/200 ; 0, -1/200,
1/200+1/(-j*83.33)];
B = [0-j*11;0;0];
V = inv(A)*B
```

```
        0 -11.0000i
   -3.2419 -  5.9461i
   -2.5905 +  0.2714i
```

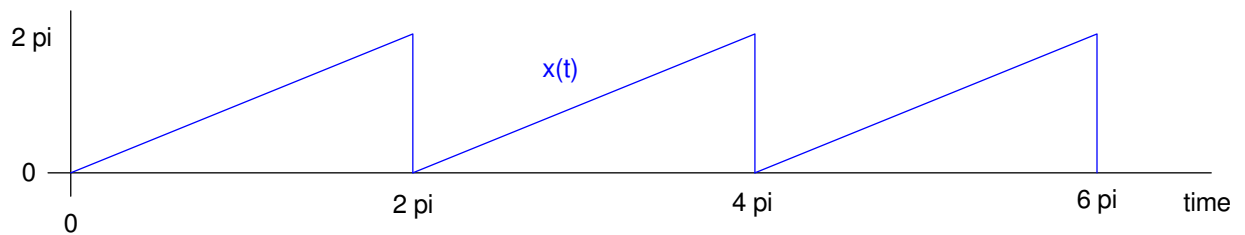6) Determine the first 5 terms of the Fourier series approximation to x(t)

$$T = 2\pi$$

$$x(t) = x(t + T)$$

$$x(t) = t \qquad\qquad\qquad\qquad 0 < t < T$$

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

a0	a1	b1	a2	b2
3.1415	0	-1.9997	0	-0.9999


```
t = [0:0.001:2*pi]';
x = t;
a0 = mean(x)

a0 =    3.1415

a1 = 2*mean(x .* cos(t))
a1 =    6.2928e-004

b1 = 2*mean(x .* sin(t))
b1 =    -1.9997

a2 = 2*mean(x .* cos(2*t))
a2 =    6.2928e-004

b2 = 2*mean(x .* sin(2*t))
b2 =    -0.9999

a3 = 2*mean(x .* cos(3*t))
a3 =    6.2928e-004

b3 = 2*mean(x .* sin(3*t))
b3 =    -0.6666

a4 = 2*mean(x .* cos(4*t))
a4 =    6.2928e-004

b4 = 2*mean(x .* sin(4*t))
b4 =    -0.4999

a5 = 2*mean(x .* cos(5*t))
a5 = 6.2928e-004

b5 = 2*mean(x .* sin(5*t))
b5 =    -0.3999
```