Topics for Today:

- Announcements
  - Partnered homework now possible, now thru end of semester.
  - Nov 3rd - Detailed Term Project outline (in format of report Table of Contents) + complete list of references.
  - Software: online students - apply for ATP/ATPDraw license, verify licensing when you receive it by e-mail, and we will mail you the install CD.
  - ASPEN software - arranging to run off of MTU server via internet.
  - Office: EERC 623. Phone: 906.487.2857
  - Recommended problems & all solutions: Ch.7, 8 solns now posted.

- Chapter 7, 10 - Network Equations, Basic Fault applications
  - Fault current - dc offset. Section 10.1
  - Importance of X/R ratio
  - Circuit breaker ratings
  - Three-Phase fault calcs using [Zbus]. Section 10.3
  - Fault current contributions using [Zbus]. Eqn. (10.21)
  - Admittance approach using [Ybus]
Objectives: Familiarization with most basic MatLab usage: entering complex numbers, matrix operations used to solve node equations, admittance and impedance matrices, plotting a simple waveform, etc.

Getting started: If you have not already, go thru the Matlab video tutorials posted on the EE5200 web page. From inside the Matlab program, you can also access tutorials by pressing F1 for Help, and then clicking on "Getting Started." Do this assignment with the goal of developing basic skills and making useful notes that you yourself will continue to refer back to. Hint to save a lot of time: make generous use of the e-mail forum to ask for and share ideas on even the most basic issue.

1) Referring to the circuit below, assume $E_1 = 120/0^\circ$ V, $E_2 = 100/-20^\circ$ V, and $E_3 = 120/30^\circ$ V.
   a) form $[Y]$ and enter the matrix into matlab (entries are complex numbers!),
   b) use MatLab to solve the matrix equation $[Y][V] = [Iinj]$ for the 3 node voltages.
   c) confirm your solution is correct - confirm KCL at node 2.
   d) invert $[Ybus]$ to get $[Zbus]$.

2) A graphing (use Matlab "plot" function) exercise. In this case, save and execute your program as an .m file. Let's investigate the well-known Gibbs effect which occurs when the infinite series that defines a square wave is truncated. (see http://en.wikipedia.org/wiki/Gibbs_phenomenon)

   \[ V_{square}(t) = V_p \sin(\omega t) + \frac{V_p}{3} \sin(3\omega t) + \frac{V_p}{5} \sin(5\omega t) + \ldots \]

Write a double for-loop which fills 2 storage vectors with the values of $V_{square}(0..0.05)$ and the corresponding time values for $\Delta t = 10 \mu s$, for truncation after $m$ terms. Assume 60-Hz fundamental and $V_p = 10$ V. Plot the waveform.
\[ V_{\text{Square}}(t) = V_p \sin(\omega t) \quad m = 1 \]

\[ + \quad V_p \sin(3\omega t) \quad m = 2 \]

\[ + \quad \frac{V_p}{5} \sin(5\omega t) \quad m = 3 \]

\[ + \quad \ldots \quad m = \infty \]

\[ \frac{m}{1 \rightarrow 1} \]

\[ 2 \rightarrow 3 \]

\[ 3 \rightarrow 5 \]

\[ 4 \rightarrow 7 \]

\[ 5 \rightarrow 9 \]

\[ 0 \quad 5001 \]
\[ t = 0 \]

\[ v_p \]

\[ 0.05 \text{s} \quad f = 60 \]

\[ dt = 10 \mu s \]

\[ t_{end} = 0.05 \]

\[ NPTS = \frac{t_{end}}{dt} + 1 \]

\[ t = \text{zeros} (1, NPTS) \]

\[ v = \text{zeros} (1, NPTS) \]

\[ NTURNS = \_ \]

\[ \omega_E = 2 \pi f + f \]
for \( n = 1 : NPTS \)
\[
t(n) = (n-1) dt
\]
for \( m = 1 : NTRMs \)
\[
u(n) = u(n) + \frac{Vp}{(2m-1)} * \sin((2m-1) \omega n + \theta)
\]
end
end

plot(\( u(n) \)) →
plot(\( x,y \))
i.e. \( (t,u) \)
50 terms

5 terms
Thevenin Equivalent

Section 10.1

Eq (10.2)

$V_{th}$

$Z_{eq}$

$i_{sc}$

$t=0$

R-L time constant

Natural response

DC offset due to $XL/R$ ratio and inception angle

Forced response