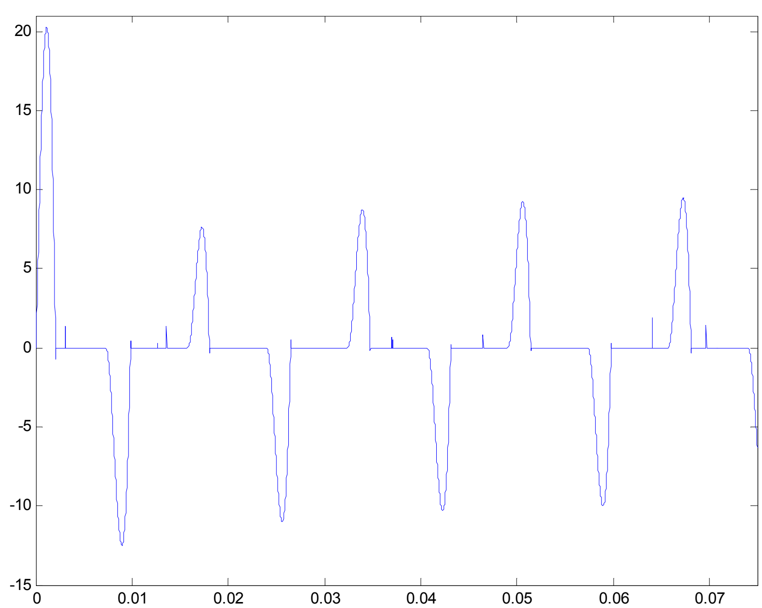
ECE 320: Lecture 1
Notes

- Course syllabus passed out and discussed.
- This is significant change from the old EE320. The old course had 4 credits of lecture plus 1 credit of lab, although it was often taught as if there was 3 credits of lecture and 2 credits of lab.
- This course will concentrate on analysis of single phase ac systems, transformers, dc machines, dc-dc power converters, single phase diode rectifiers and switched mode power supplies (this is the type of power supply that appears in most personal computers) per unit analysis and introduce the analysis of large system

1. The ac currents drawn by diode rectifiers brings in some of the harmonic analysis you learned in EE 212. The rectifier front end on a computer power supply will draw a curre waveform similar to the one shown below. The 3rd harmonic (180Hz component) is near as large as the fundamental component. In a 3 phase system, these currents will add in the neutral have resulted in burning up neutral wires in some buildings.

   Note, that in office buildings (or most buildings on campus), there is a 3 phase supply, with single phase distribution going down different hallways, wings, floors, etc. and an approximate balanced load. If there are a lot of computers in the system, the neutral currents might be as large or larger than the 60 Hz part of the phase currents. Older buildings had smaller gauge wires for the neutral wires.



AC Current Drawn by a computer power supply

2. Per unit normalization makes it easier to quickly analyze the voltage measurements or calculations on a large system with different voltage levels due to transformers and get a quick estimate of which voltages are within acceptable norms (within 90% and 105% of rated voltage)

3. The analysis of large systems requires matrix methods. For example, the western power grid is a large interconnected system covering all of North America from Colora to the West coast, and from central British Columbia to the border with Mexico. There sometimes strong interactions, for example the Northridge Earthquake in California caused a blackout in Southeastern Idaho. Planning engineers at Avista will model this entire system, which include approximately 2400 nodes.

- ECE 320 will cover topics that we would like to see every electrical engineer know.
- There will be a follow-on course, ECE 420 which will cover 3 phase systems, synch
- Since this is the first time for this course, the actual time spent on some of the topics may be a perfect match with the course syllabus

Basic AC Circuit Analysis

Instanteous Quanties:

$$v(t) = V_m \cos(\omega \cdot t + \phi)$$

- Instaneous quantities will be written with lower letters
- Vm is the peak amplitude (from zero to the peak of the sinusoid)
- ϕ is the phase angle
- ω is in rad/sec, but we usually write ϕ in degrees. Be careful when performing calculatic
- $2*\pi$ radians = 360 degrees (1 full cycle of the sinusoid)
- $\omega = 2*\pi*f$ (f is the frequency in Hz)
- $T = 1/f$ (period for 1 cycle).

RMS Phasors

- We are normally interested in steady-state behavior of a circuit
- We might keep track of the peak of the cosine wave, but it is often better to use an averaged measurement. Since the average value of a sinusoidal waveform is zero, something else is needed.
- The room mean square (RMS) value is most commonly used.

$$V_{rms} = \sqrt{\frac{1}{T} \cdot \int_{T}^{t_o+T} (v(t))^2 \, dt}$$

- However, for a pure sinusoidal waveform:

$$V_{rms} = \frac{Vm}{\sqrt{2}}$$

- To describe the steady-state behavior we use a magnitude (RMS magnitude) and the angle. The frequency is assumed.

- This quantity is defined based on the cosine function for the sinusoidal quantity.

$$\vec{V} = |V| \cdot e^{j \cdot \phi}$$