Lecture #3
DC and AC measurements

EE 211

Spring, 2005

Best titles from Writing Assignment 1

- Measured value and tolerance conformity of 270 ohm resistors
- Measured resistance of ten 180 ohm resistors, and the mean and standard deviation of the sample.
- Measurements and statistics for 10 8.2kohm 10% tolerance resistors
- A sample of 10 resistors and the corresponding statistical analysis

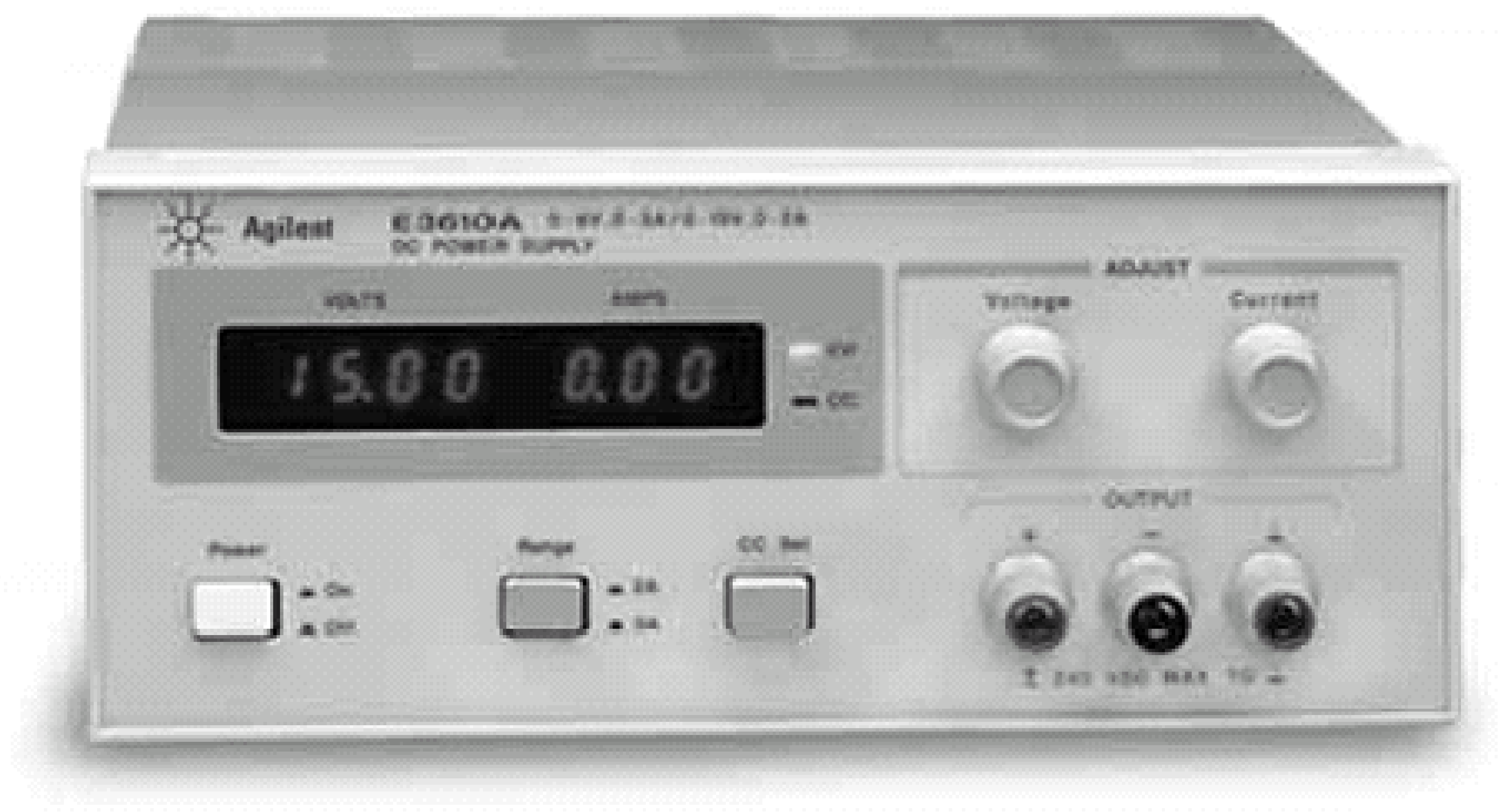
Writing Assignment #1

- Questions?

DC Circuit Analysis

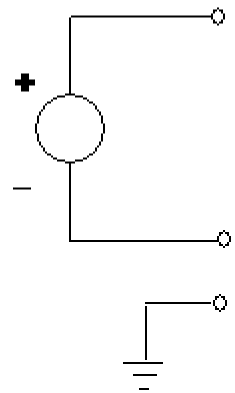
- DC Power supply
- Load lines
- Thevenin equivalents
- Maximum power transfer

DC Bench Power Supply



Features

- Three output studs– pos, neg, and ground



- Two control knobs– voltage and current
- Built in amp/volt meter

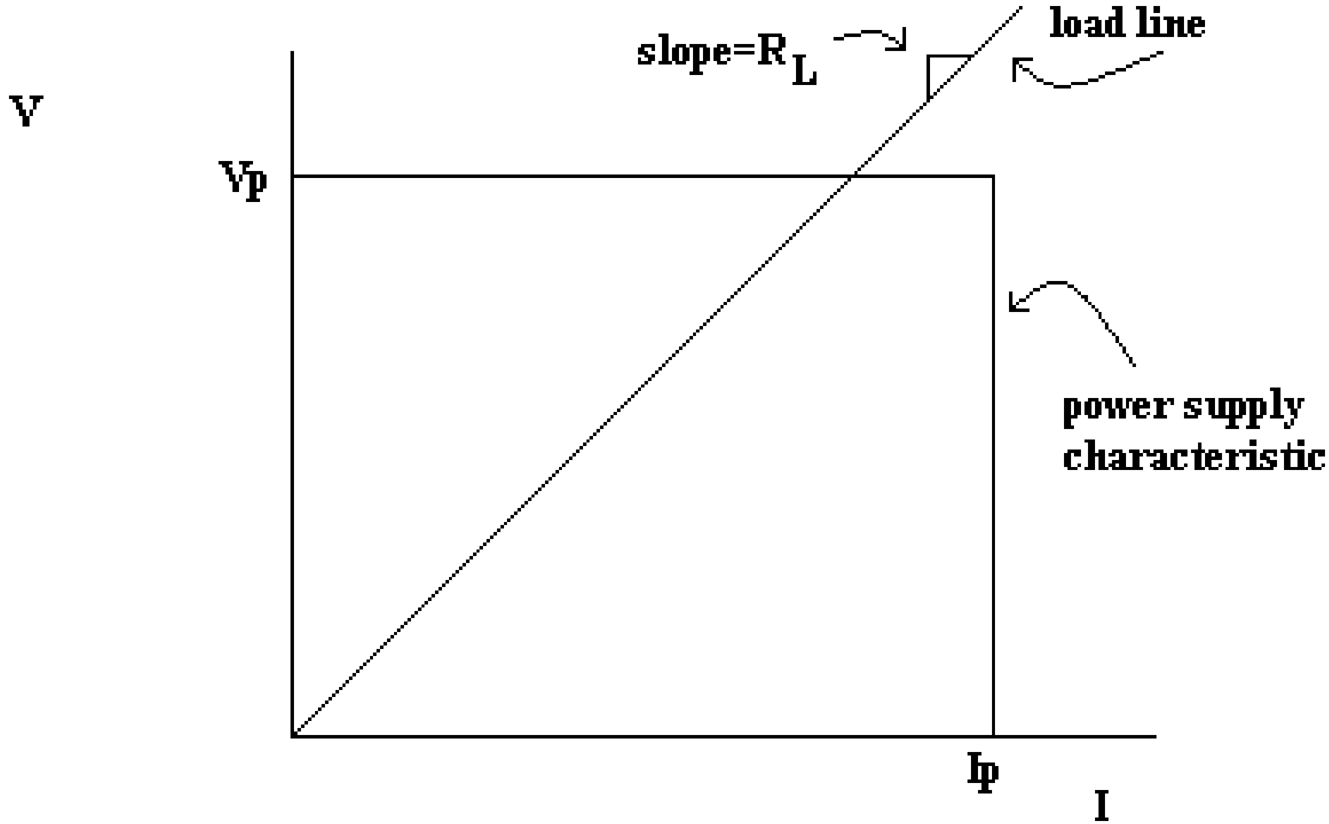
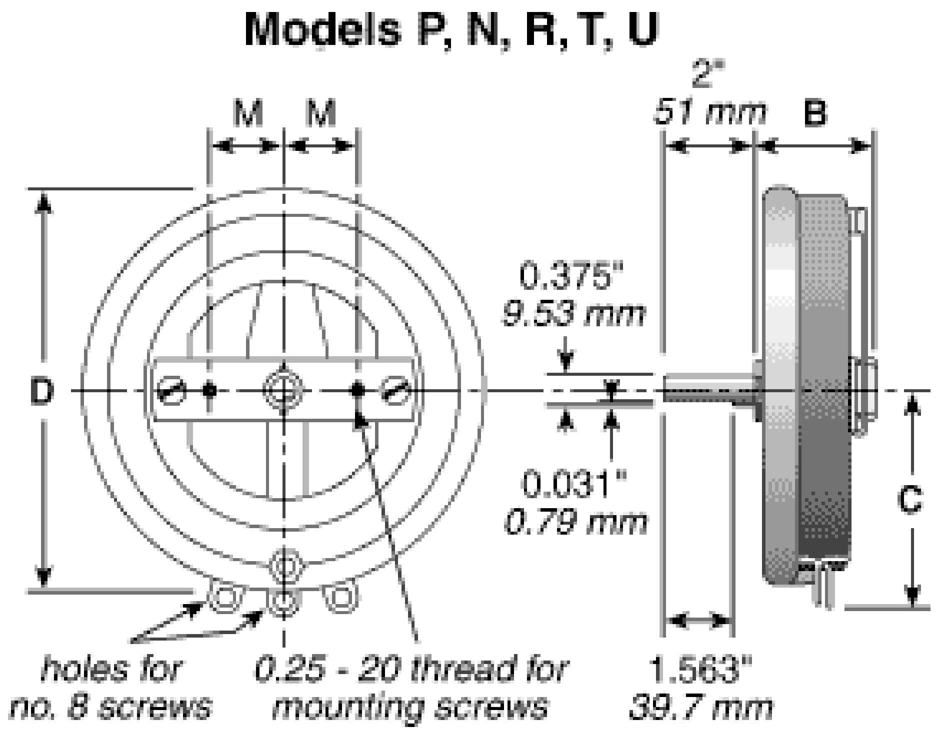


Figure 1. Power supply and load characteristics

Rheostat



Models P, N, R, T, U
M
M
2"
51 mm
B
D
0.375"
9.53 mm
0.031"
0.79 mm
C
holes for
no. 8 screws
0.25 - 20 thread for
mounting screws
1.563"
39.7 mm

Part 1. Power Supply/Rheostat circuit to measure power supply characteristic

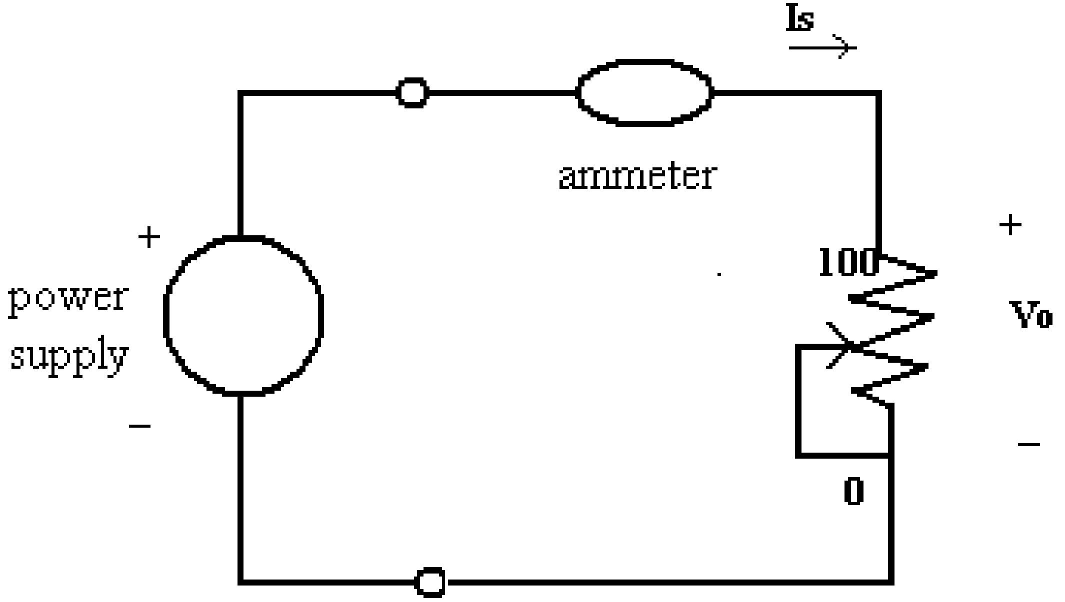


Figure 2

Plotting Load Lines

- Plot the V-I curve of the power supply for the settings that you put on the supply.
- For each rheostat setting, plot the V-I curve of the rheostat.
- Verify that the circuit is operating at the intersection of the source and load plots.
- Verify the the power supply operates along its plotted curve.

Part 2. Find the Thevenin equivalent by measurement.

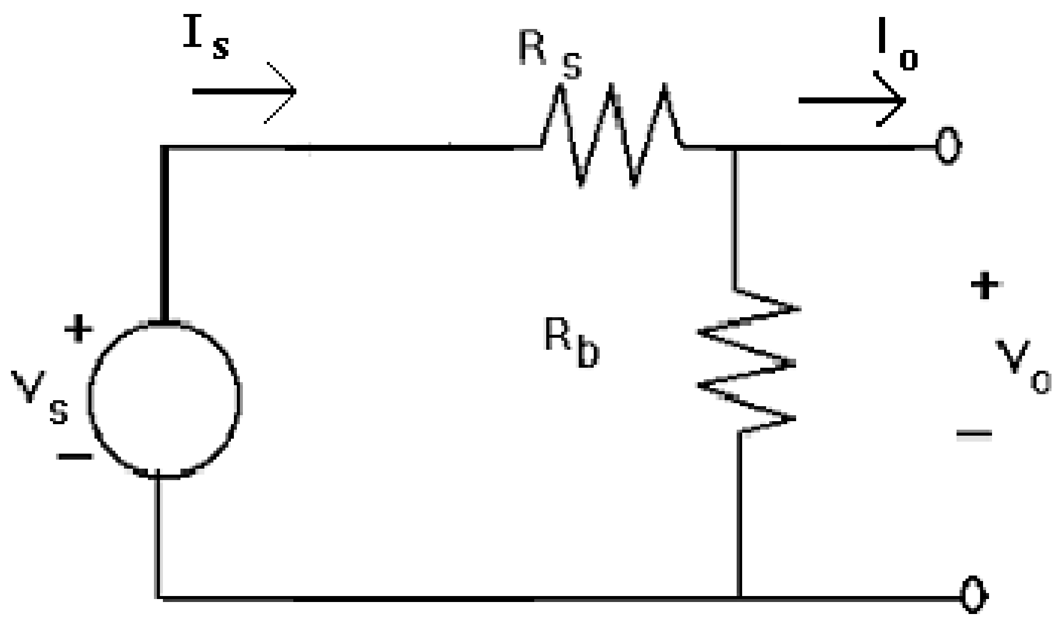
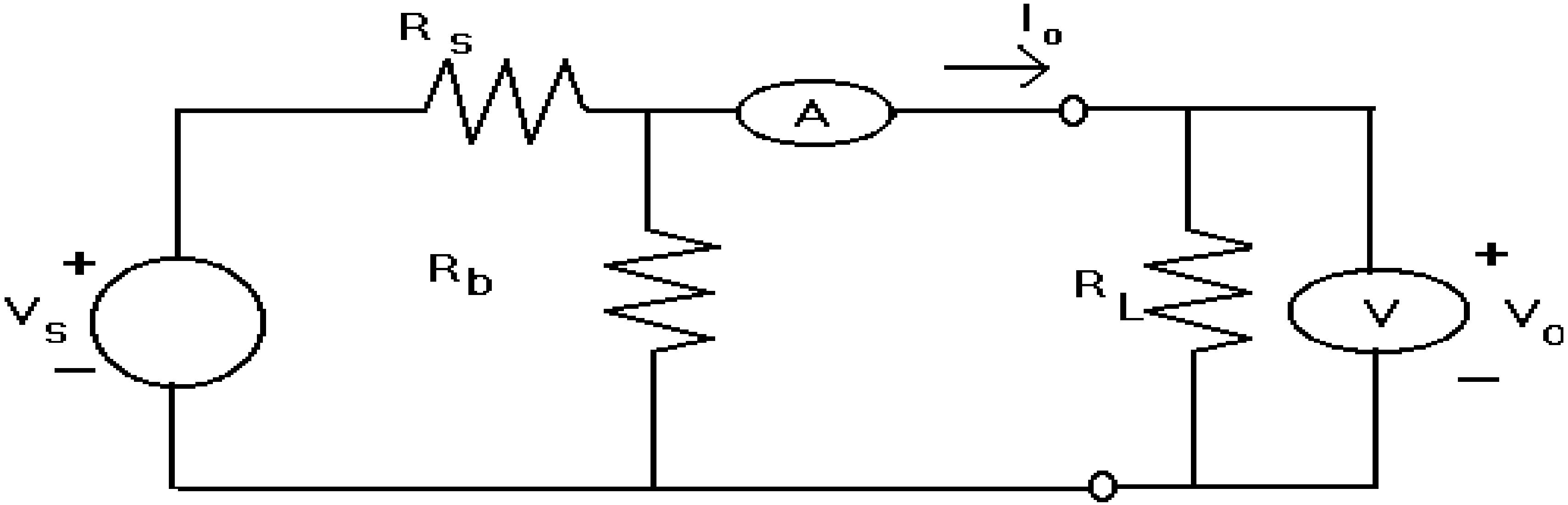
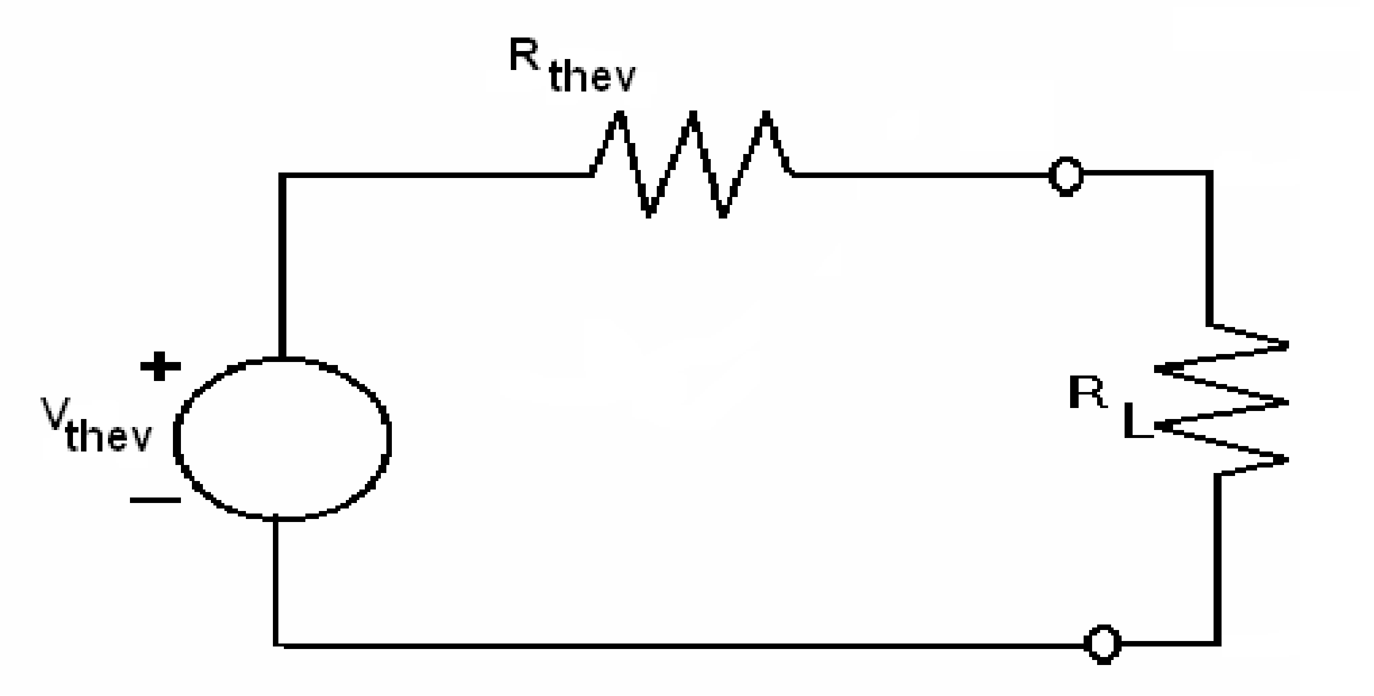


Figure 3.

Part 3. Determine the maximum power transfer to R_L



What load resistance leads to maximum power transfer to R_L?



Maximum Power Transfer

- Review Section 5.7 of Dorf and Svoboda on maximum power transfer.
- Verify by experiment that the theory of maximum power transfer presented in this section is correct.

DC circuits-- Summary

- Measure the power supply characteristic, and determine circuit operating point by plotting load lines.
- Determine the Thevenin equivalent of a circuit by measurement
- Determine the maximum power transfer capability by measurement
- Compare these with the theory

Lab 6. AC signals- nonsinusoidal

- Review of the concepts of rms, peak, p-p, etc. for nonsinusoidal signals.
- Pulse trains– definitions and measurements.
- Amplitude modulated signals.

Nonsinusoidal signals

$$V_{dc} = \frac{1}{T} \int_{t=0}^{T} v(t)dt$$

$$V_{rms} = \frac{1}{T} \int_{t=0}^{T} v^2(t)dt$$

Other definitions

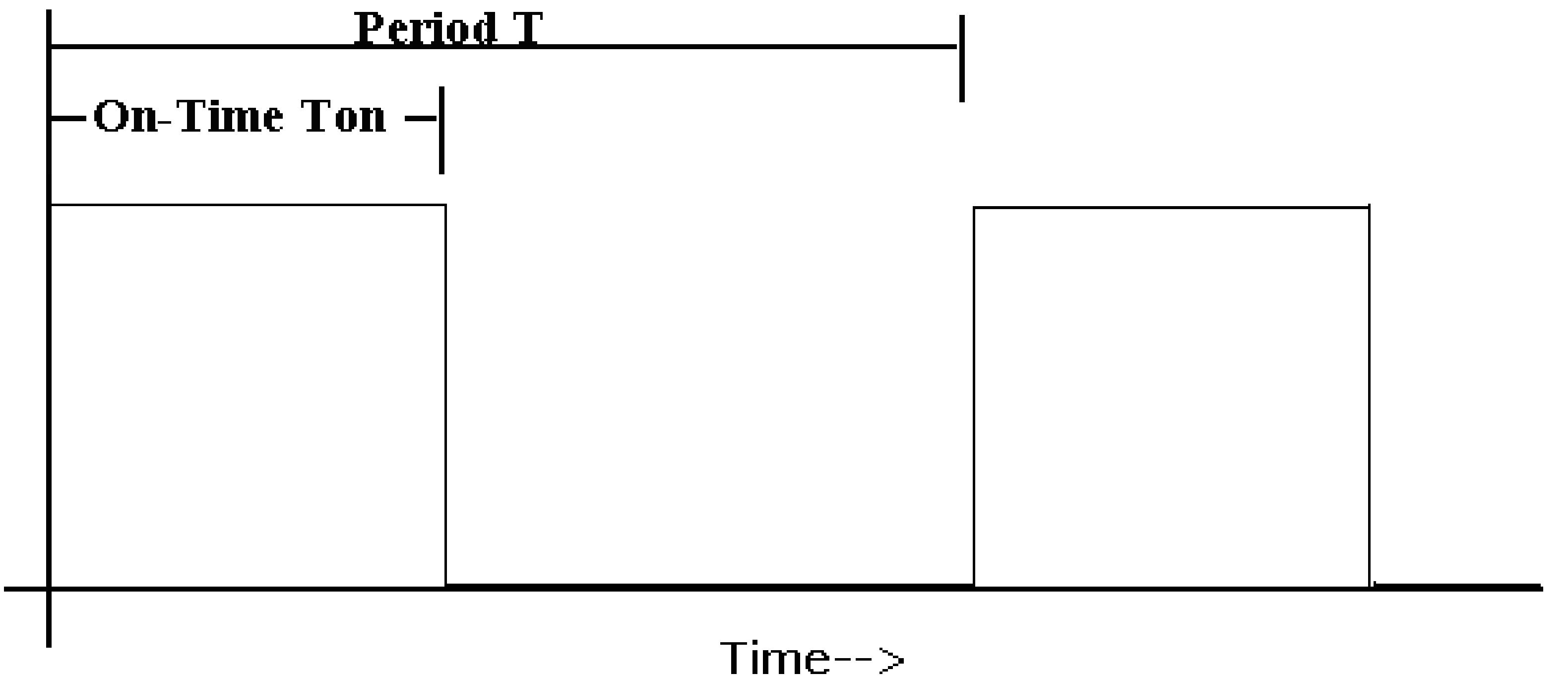
- Peak voltage
- Peak-peak voltage
- AC RMS voltage– the rms component of a signal with the dc value removed

$$V_{rms} = \left(V_{dc}^2 + V_{acrms}^2\right)^{1/2}$$

For ac waveforms

- Crest Factor= $\dfrac{V_{peak}}{V_{rms}}$

Pulse trains

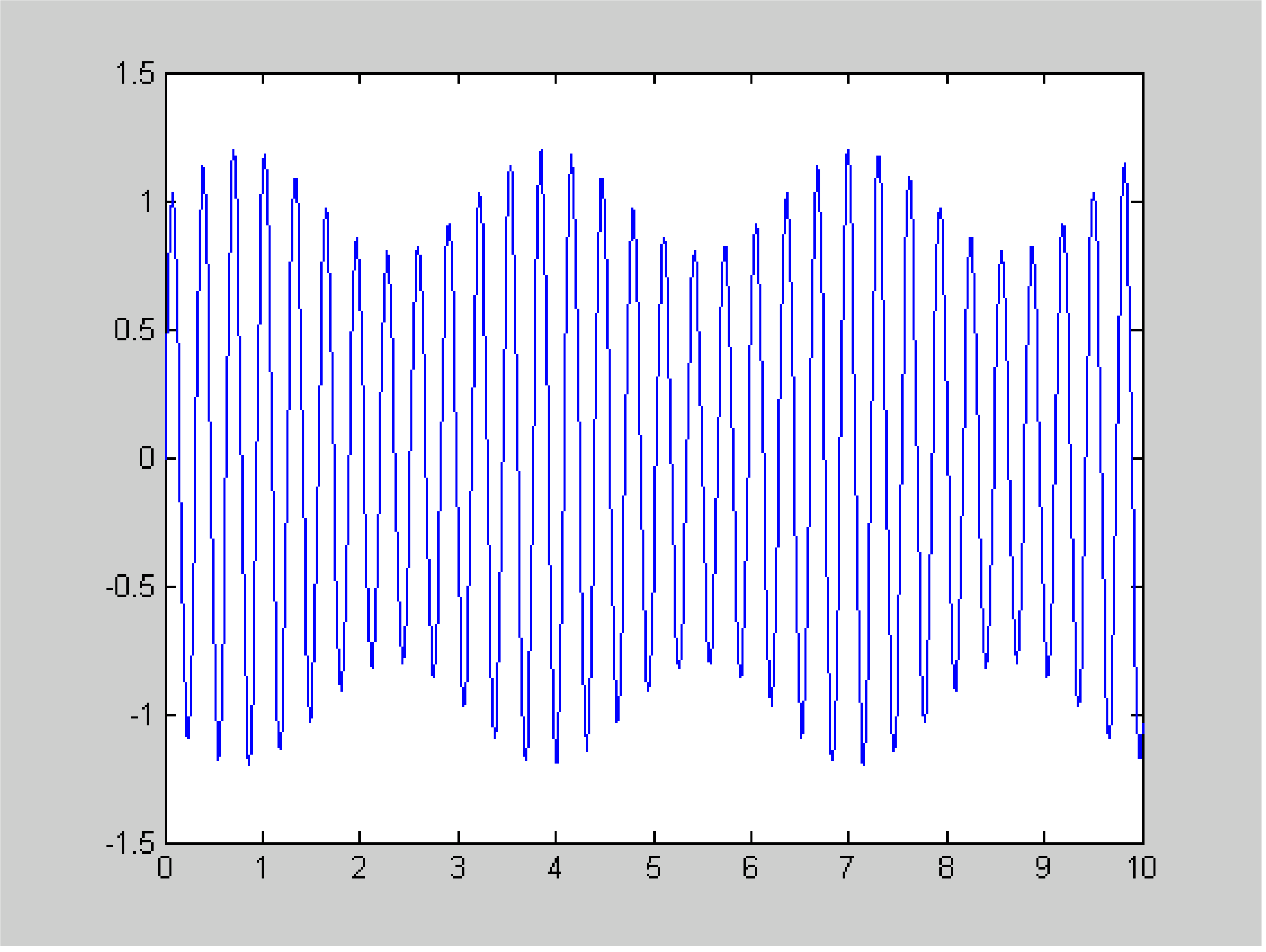


Pulse trains

Duty Cycle = T_{on}/T

$$V_{rms} = \sqrt{\frac{1}{T}\int_{t=0}^{DT} V_{on}^{2}\,dt}$$

$$V_{dc} = \frac{1}{T}\int_{t=0}^{DT} V_{on}\,dt$$


1.5
1
0.5
0
-0.5
-1
-1.5
0
1
2
3
4
5
6
7
8
9
10

Amplitude Modulation

An amplitude modulated wave is

$$v(t) = A_c[1 + v_{sig}(t)]\cos(\omega_c t)$$

where carrier wave is modulated with the signal wave

Pre-Labs

- DC Circuits
  - Read the assigned material from Dorf & Svoboda– Section 5.7 for maximum power transfer plus sections on Thevenin equivalents and dc power.
- AC nonsinusoidal–
  - Calculate the dc, rms and ac rms values of the sine, triangle, and square waves and the pulse trains.