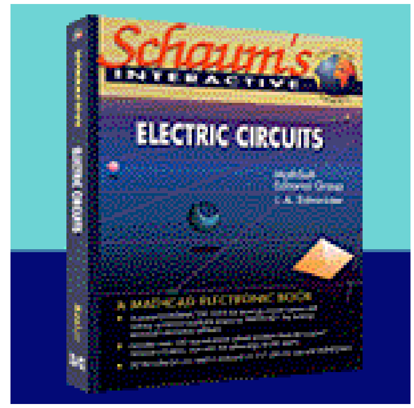
Schaums Interactive Outline Series:

Electric Circuits



Platform: Windows
Includes the Mathcad Engine; requires 4 MB hard disk space
Available for ground shipment

This Electronic Book provides comprehensive interactive on-line access to over 100 solved problems in electric circuit theory. It's excellent for self-study, to augment classroom material, or as a reference for common circuit analysis techniques. Problems have been selected from the original Schaum's *Outline Series* from McGraw-Hill and converted into Mathcad worksheets, complete with a theoretical review section corresponding to each chapter in the original book. And because the Mathcad Engine is built in, the math is "live" and interactive. When you change a variable, the software recalculates results instantly.

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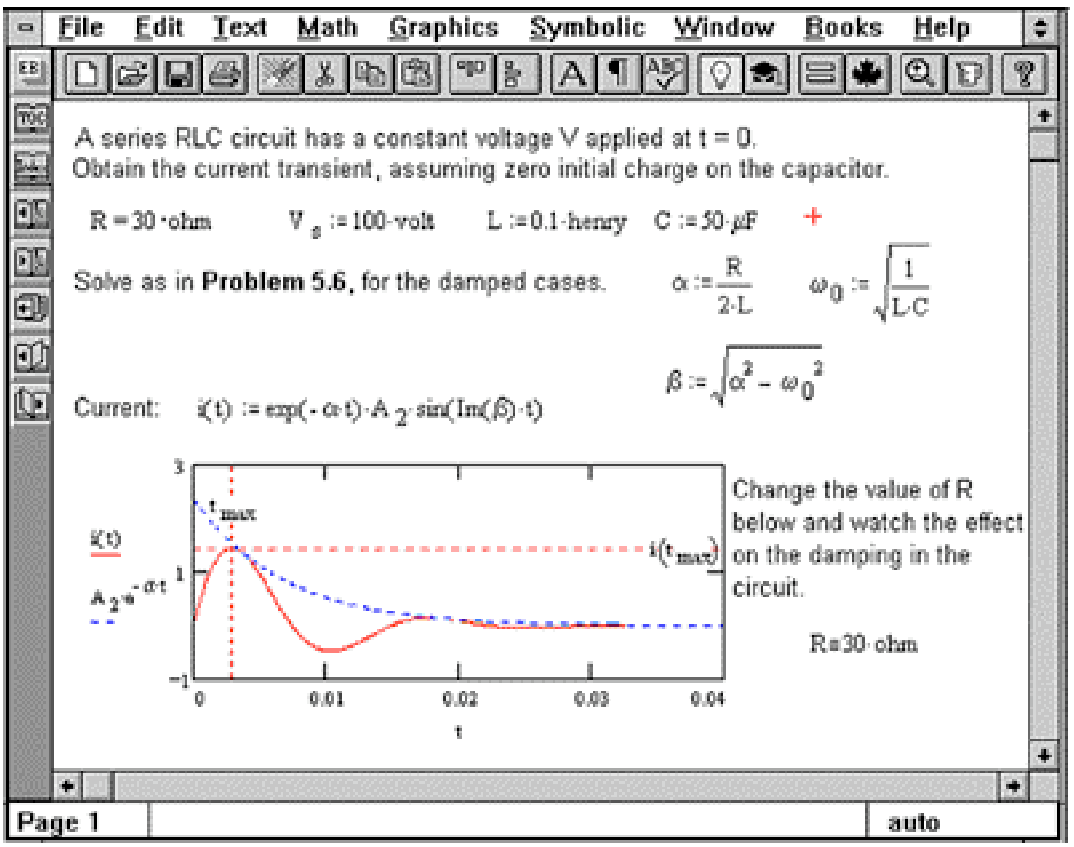

Given voltage resistance inductance and capacitance values, obtain the equation for the current transient. Then observe the effect varying resistance has on the damping of the circuit.

Topics include: Voltage and Current Relations, Equivalent Circuits and Network Reduction, Power and Power Factor Analysis, Transient Phenomena, Laplace and Fourier Transforms, Frequency Response and Resonance, Sinusoidal Steady State Network Analysis, Polyphase Circuits, Coupled Circuits and Transformers, and more.

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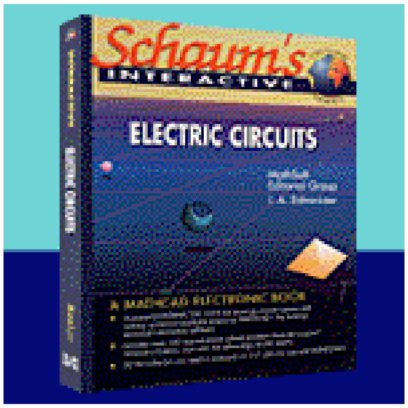

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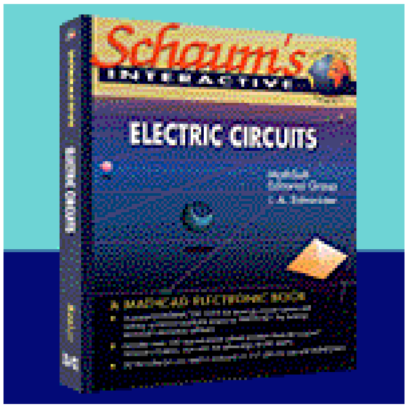

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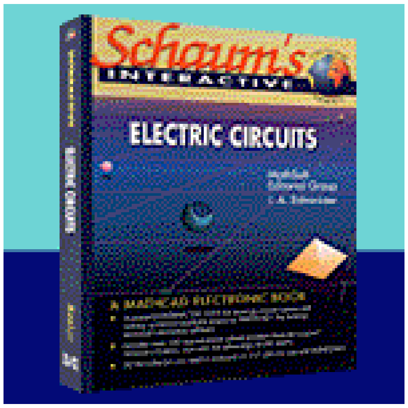

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Chapter 5 - Solved Problems

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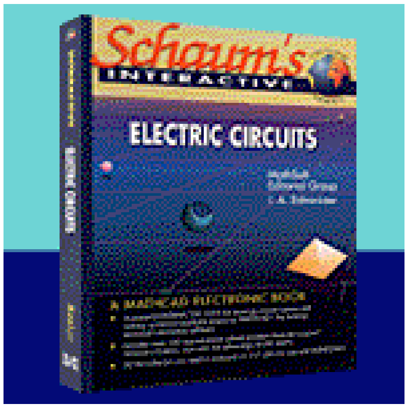
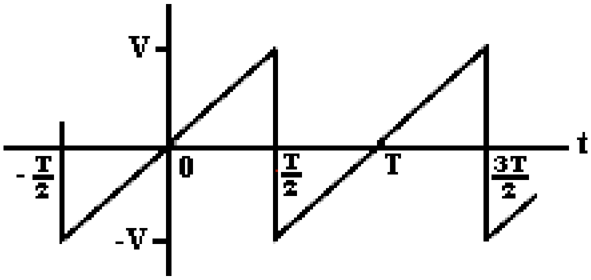


Fourier Series of a Sawtooth Wave

Statement

Find the trigonometric Fourier series for the sawtooth wave shown below, plot the line spectrum, and reconstruct the waveform.



System Parameters

$V := 1 \cdot volt$ $\qquad$ $T := 2 \cdot \pi$

Solution

By inspection, the waveform is odd (and therefore has average value zero). Consequently the series will contain only sine terms. A single expression,

$$\omega := \frac{2 \cdot \pi}{T} \qquad f(t) := \frac{2 \cdot V}{T} \cdot \omega \cdot t$$

describes the wave over the period from -pi to +pi, and we will use these limits on our evaluation integral for **bn.**

$$n := 0..10 \qquad b_n := \frac{2}{T} \cdot \left[\int_{-\frac{T}{2}}^{\frac{T}{2}} \frac{2 \cdot V}{T} \cdot \omega t \cdot \sin(n \cdot \omega t)\, d\omega t \right] \qquad a_n := 0 \cdot volt$$

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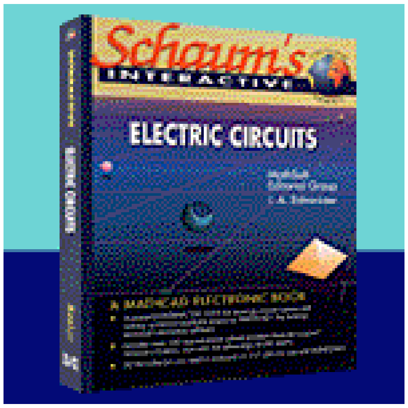
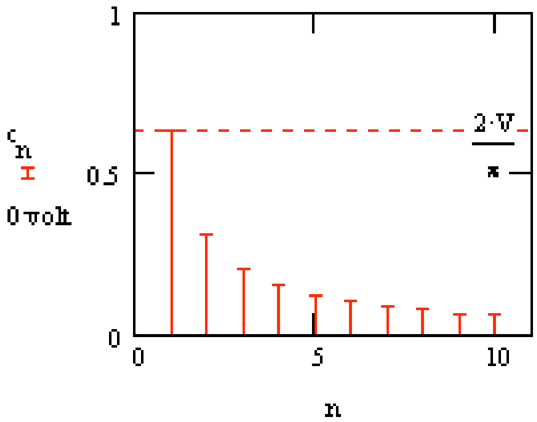


The line spectrum is prepared by first defining the harmonic amplitudes from the Fourier coefficients:

$$c_n := \sqrt{(a_n)^2 + (b_n)^2}$$

The line spectrum is made with error bars, just as described in Problem 12.1.



Solving the coefficients symbolically yields:

$$b_n = \frac{1}{\pi} \cdot \left[\int_{-\pi}^{\pi} \frac{V}{\pi} \cdot u \cdot \sin(n \cdot u)\, du \right] \qquad b_n = \frac{2}{\pi^2} \cdot (\sin(n \cdot \pi) - n \cdot \cos(n \cdot \pi) \cdot \pi) \cdot \frac{V}{n^2}$$

$$\sin(n \cdot \pi) = 0$$

Therefore,

$$b_n = -\frac{2}{\pi^2} \cdot (n \cdot \cos(n \cdot \pi) \cdot \pi) \cdot \frac{V}{n^2} \quad \text{or} \quad b_n = c_n = \frac{-2}{\pi \cdot n} \cdot \cos(n \cdot \pi) \cdot V$$

The coefficients decrease as 1/n, and thus the series converges slowly, as shown by the spectrum.

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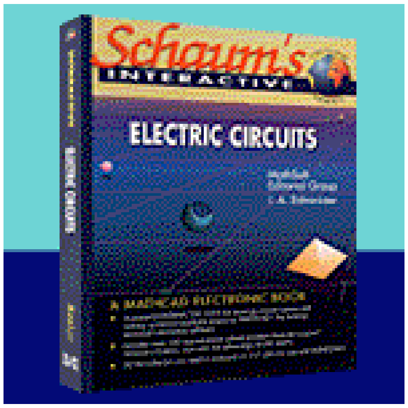

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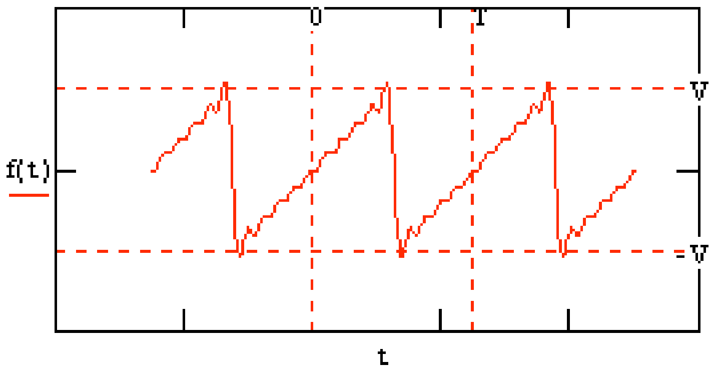
To reconstruct the waveform, the expression is

$$f(t) := \sum_{n} b_n \cdot \sin(\omega \cdot n \cdot t) \qquad t := -T, -.99 \cdot T .. 2 \cdot T$$



How would you need to change this analysis to match the sawtooth wave shown in the beginning of Chapter 12? How do the new coefficients affect the line spectrum?