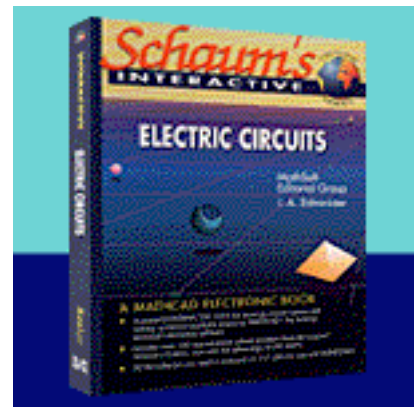


Schaums Interactive Outline Series: *Electric Circuits*

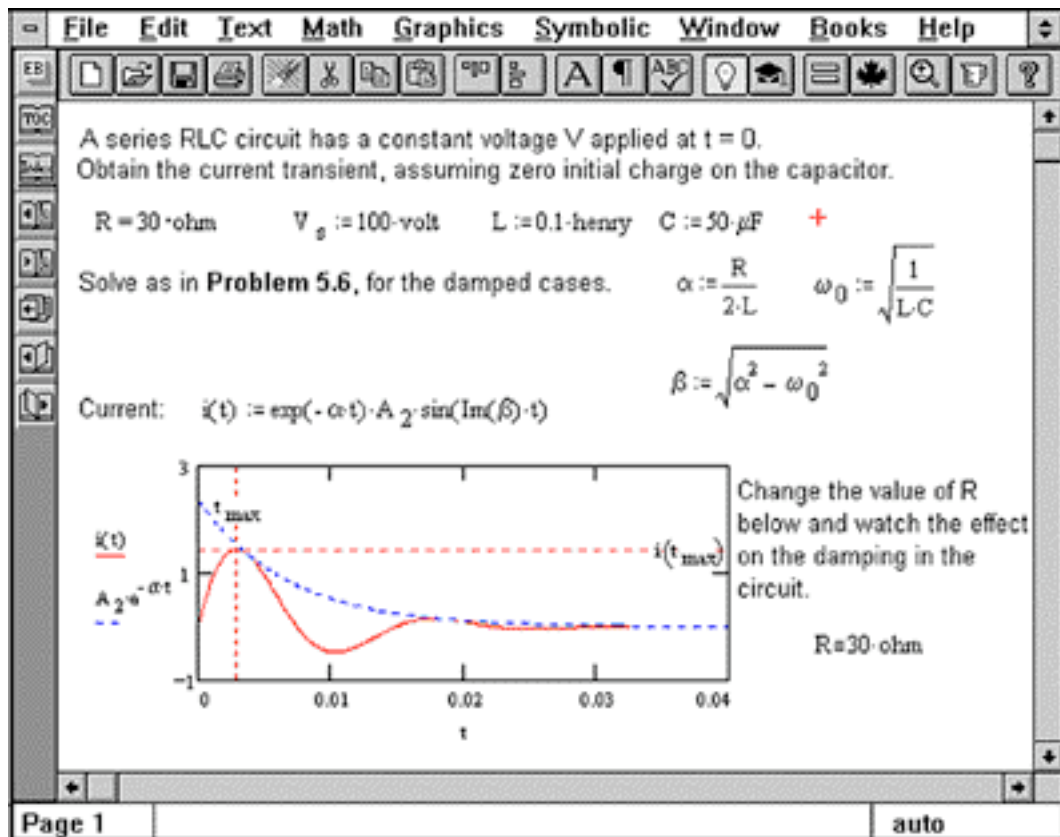


Platform: Windows

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.

[Table of Contents](#)[Product Sample](#)[Back to Product List](#)

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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Electric Circuits

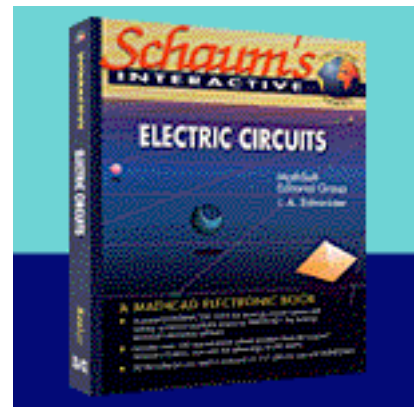


TABLE OF CONTENTS (page 1 of 3)

Chapter 1 - Solved Problems

Unit Conversion: Orders of Magnitude
Steady State Impedance
Rectilinear Motion
Work and Force
Unit Conversion: Amps to Charge
Unit Conversion: Energy to Volts
Power Dissipation
Average Power and Energy
Unit Conversion: Joules to Kilowatt-hours
Current and Charge Transfer

Chapter 2 - Solved Problems

Current Dependent Voltage Source
Current Dependent Current Source
Power Conversions I
Power Conversions II
Power Conversions: Absorbed vs Delivered Power
Power Conversions: Power Distribution
Equivalent Resistance
Ohm's Law: Ohm's Law with Time Variance
Ohm's Law: Graphical Application of Ohm's Law
Equivalent Impedance: Equivalent Series Inductance
Equivalent Impedance: Equivalent Inductance by Superposition
Equivalent Impedance: Equivalent Series Capacitance
Equivalent Impedance: Equivalent Parallel Capacitance
Capacitor Charge Determination
Determining a Circuit Element from its VI Characteristics
RLC Circuit Analysis
Capacitor Voltage and Charge Relations
RC Energy Transfer

[Product Sample](#)

[Back to Product List](#)

Schaums Interactive Outline Series:

Electric Circuits

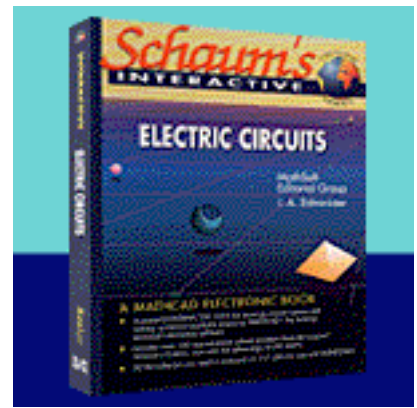


TABLE OF CONTENTS (page 2 of 3)

Chapter 3 - Solved Problems

- VI Characteristics
- Internal Series Resistance I
- Internal Series Resistance II
- KVL: Dependent Voltage Source
- Designing a Current Source
- Power Rating Limitations
- KCL: Uniqueness of Solutions
- KCL: Power Calculations
- Dissipated Energy in a Resistor
- Power and Efficiency
- Determining Dependent Parameters
- KVL: Voltage from Power
- Analysis of a Ladder Network
- KCL: (Simulated) Nodal Analysis
- Network Reduction I
- Node Resistance
- Network Reduction II
- Superposition
- The Thévenin Equivalent
- The Norton Equivalent
- The Thévenin Equivalent with Dependent Sources
- Thévenin to Norton Conversions
- Maximum Power Transfer to Load

Chapter 4 - Solved Problems

- KVL Network Analysis
- Mesh Analysis: Current
- Mesh Analysis: Input Resistance
- Mesh Analysis: Branch Currents
- Mesh Analysis: Alternate Loops
- Mesh Analysis: Mesh Current Matrix Equation
- Node Analysis versus Mesh Analysis
- Node Analysis: Solving for a Current
- Node Analysis: Solving for a Source Voltage
- Node Analysis: Finding Resistor Currents
- Independent Loops
 - Transfer Resistance
 - Mesh Analysis: Thévenin Equivalents
 - Mesh Analysis: Two-Source Circuit

[Product Sample](#)

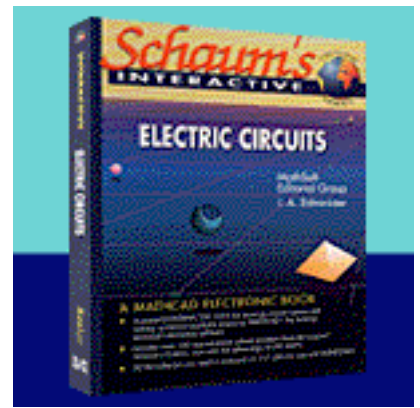
[Back to Product List](#)

Schaums Interactive Outline Series: Electric Circuits

TABLE OF CONTENTS (page 3 of 3)

Chapter 5 - Solved Problems

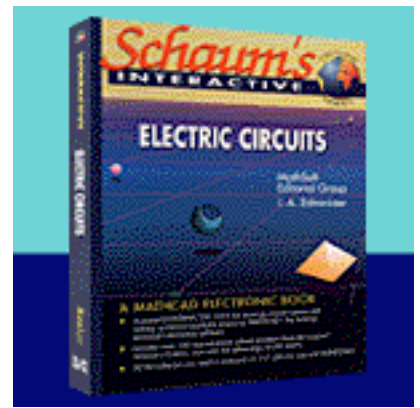
The RC Circuit: Current and Charge Transients
The RC Circuit: Power and Energy Transients
The RC Circuit: Non-zero Initial Charge
The RL Circuit: Voltage Transients
The RL Circuit: Power Transients
The RC Circuit: Circuit Transients at Turn-on
The RC Circuit: Circuit Transients at Turn-off
The RC Circuit: Switched Voltage Sources
The RL Circuit: Time Constants
The RL Circuit: The Two-Point Method
The RL Circuit: Current Transient in a Two-Switch Circuit
The RC Circuit: Transients with Network Reduction
The RL Circuit: Transients with Network Reduction
The Series RLC Circuit: Overdamped Case
The Series RLC Circuit: Oscillatory Case
The Series RLC Circuit: Oscillatory Case with Initial Charge
The RC Circuit: Transients with Parallel R's and C's
The RL Circuit: Transients with Parallel Inductance
The RL Circuit: Transients with a Sinusoidal Drive
The RL Circuit: Transients from Step Function Sources
The RC Circuit: Transients from Step Function Sources



[Product Sample](#)

[Back to Product List](#)

Schaums Interactive Outline Series: Electric Circuits

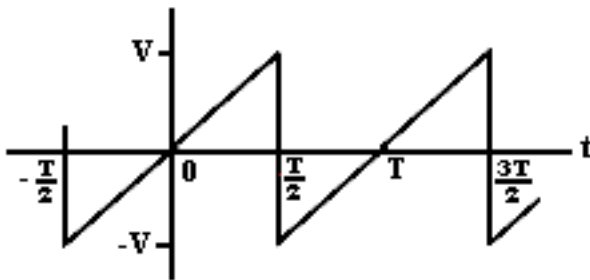


SAMPLE PAGE (page 1 of 3)

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

$$V := 1 \cdot \text{volt}$$

$$T := 2 \cdot \pi$$

Solution

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

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

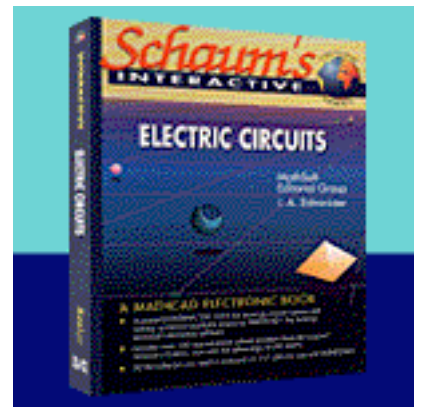
describes the wave over the period from $-\pi$ to $+\pi$, and we will use these limits on our evaluation integral for b_n .

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

[Table of Contents](#)

[Back to Product List](#)

Schaums Interactive Outline Series: Electric Circuits

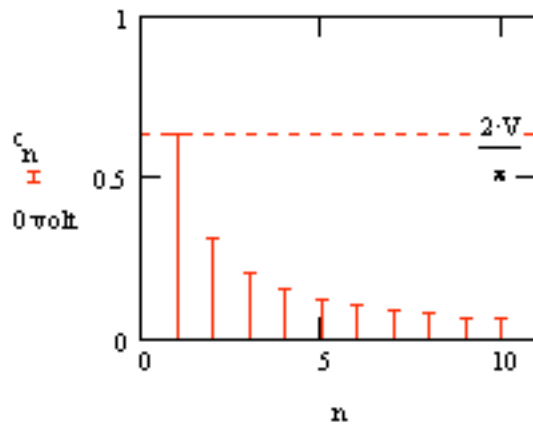


SAMPLE PAGE (page 2 of 3)

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:

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

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

Therefore,

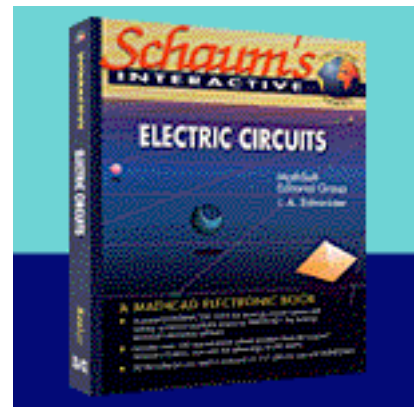
$$b_n = -\frac{2}{\pi^2} \cdot (n \cdot \cos(n \cdot \pi) \cdot \pi) \cdot \frac{V}{n^2} \quad \text{or} \quad b_n = c_n = \frac{-2}{\pi \cdot n} \cdot \cos(n \cdot \pi) \cdot V$$

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

[Table of Contents](#)

[Back to Product List](#)

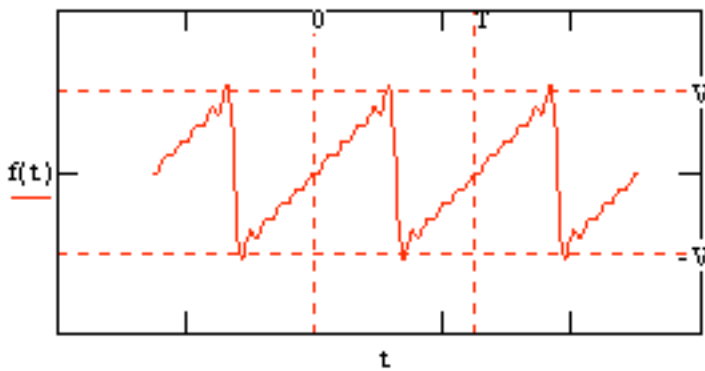
Schaums Interactive Outline Series: Electric Circuits



SAMPLE PAGE (page 3 of 3)

To reconstruct the waveform, the expression is

$$f(t) := \sum_n b_n \cdot \sin(\omega \cdot n \cdot t) \quad t := -T, -.99 \cdot T .. 2 \cdot T$$



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?

[Table of Contents](#)

[Back to Product List](#)