Applications of Mathematics in Circuit Theory

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Abstract – Application of Gaussian in circuit theory, using Kirchhoff's 2nd law. In this paper for a given circuit, forming into matrices form by using Kirchhoff's 2nd law we solve and find the current values. Less than 3x3 matrices we can use Carmel's rule, but more that 3x3, Carmel's cannot be done, so gauss elimination method is used to find the current values for the given circuits

I. CIRCUITS

An electronic circuit is composed of individual electronic components like Transistors, Capacitors, Inductors and Diodes, Resistors connected by conductive wires or traces through which Electric Current can flow. The combination of components and wires allows various simple and complex operations to be performed, signals can be amplified, computations can be performed, and data can be moved from one place to another. Circuits can be constructed of discrete components connected by individual pieces of wire

Let R = Resistance of the circuit
   C = Capacitance in series with R
   I = Current flowing
   L = Inductor
   V_R = voltage across R.
   V_C = voltage across C
   V_L = voltage across L

II. OHM'S LAW

Ohm's law defines a linear relationship between the voltage and the current in an electrical circuit. The DC current flow through a resistor is set by the resistor's voltage drop and the resistor's resistance.

Ohm's Law Formula / Equation
When we know the voltage and resistance, we can calculate the current.

Ohm's law definition
The resistor's current I in amps (A) is equal to the resistor's voltage V_R =V in volts (V) divided by the resistance R in ohms (Ω):

$$I = \frac{V}{R}$$

In 1845, a German physicist, Gustav Kirchhoff developed a pair or set of rules or laws which deal with the conservation of current and energy within electrical circuits. Application of Gauss Elimination in circuits

III. KIRCHHOFF'S 2ND LAW

In a closed circuit the sum of the potential drops is equal to the sum of the potential rises.

In the closed loop ABCDA.

Branch	Potential drop	Potential rise
AB	IR_1	—
BC	IR_2	—
CD	IR_3	—
DA	—	V

Hence $IR_1 + IR_2 + IR_3 = V$

[Note: When we go from D to A (from the negative terminal to the positive terminal of the battery) There is a potential rise of V volts.

Assume the loop current to be I_1, I_2 and I_3 as shown in the figure, all clockwise.
The currents through R_A, R_C, R_E are I_1, I_2, I_3 respectively.
The current through R_B is $I_1 - I_2$ & through R_D is $I_2 - I_3$

Branch	Potential rise	Potential drop
PQ	$I_1 R_A$	—
QV	$(I_1 - I_2) R_B$	—
VW	—	—
WP	—	V_a —

Mathematics For Electrical Circuit Analy

Ernst A. Guillemin

Mathematics For Electrical Circuit Analy:

   The Mathematics of Circuit Analysis Ernst A. Guillemin,1965   **Mathematics for Electrical Circuit Analysis** David Philip Howson,1966   **Transients for Electrical Engineers** Paul J. Nahin,2018-07-05 This book offers a concise introduction to the analysis of electrical transients aimed at students who have completed introductory circuits and freshman calculus courses While it is written under the assumption that these students are encountering transient electrical circuits for the first time the mathematical and physical theory is not watered down That is the analysis of both lumped and continuous transmission line parameter circuits is performed with the use of differential equations both ordinary and partial in the time domain and the Laplace transform The transform is fully developed in the book for readers who are not assumed to have seen it before The use of singular time functions unit step and impulse is addressed and illustrated through detailed examples The appearance of paradoxical circuit situations often ignored in many textbooks because they are perhaps considered difficult to explain is fully embraced as an opportunity to challenge students In addition historical commentary is included throughout the book to combat the misconception that the material in engineering textbooks was found engraved on Biblical stones rather than painstakingly discovered by people of genius who often went down many wrong paths before finding the right one MATLAB is used throughout the book with simple codes to quickly and easily generate transient response curves   **The mathematics of circuit analysis** Ernst A. Guillemin,1959   **The Mathematics of Circuit Analysis** Ernst S. Guillemin,2003-03-17 A text book designed to give the engineer a reasonably complete coverage of the mathematical topics needed specifically or collaterally in the analysis or synthesis of electrical networks   *Interval Methods for Circuit Analysis* L. V. Kolev,1993 Written by an electrical engineer this book presents a novel approach in electric circuit theory which is based on interval analysis an intensively developing branch or applied mathematics Covering major topics in both circuit and system theory and their applications it suggests a variety of methods that are suited for handling linear and nonlinear analysis problems in which some or all of the relevant data are given as intervals Detailed algorithms of the interval methods presented are developed enabling their easy implementation on computers For the convenience of the reader a comprehensive survey of all the necessary interval analysis notions and techniques is provided in the introductory text Most of the theoretical developments considered in the book are also clearly illustrated through numerical examples

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techniques is provided in the introductory text Most of the theoretical developments considered in the book are also clearly illustrated through numerical examples   Electric Circuit Analysis Charles J. Monier,2001 This book establishes a clear relationship between the basic principles of electric circuit analysis and the problem solving procedures for analyzing electric currents It contains traditional topics in electric circuit analysis along with matrix methods for solving systems of algebraic equations for simultaneous solutions derivatives and integrals differential equations and Laplace transformers Chapter titles Ohm s Law and Resistance Kirchhoff s Laws and Resistor Combinations Basic Analysis Tools Numerical Methods Multi Loop Circuits Network Theorems The Operational Amplifier and Basic Measuring Devices Capacitors Inductors Mathematics for ac Circuits Network Theorems Applied to ac Circuits Two Port Networks and Three Phase Circuits A reference for professionals in technology related industries   **The Mathematics of Circuit Analysis** ,1950   Electric Circuit Analysis Steven G. Conahan,1996   **Electric Circuits** Demetrios P. Kanoussis,2015-04-06 Electric Circuits constitute a core course in every Electrical Engineering curiculum with applications covering a wide area of disciplines like Electronics Electrical Machines Frequency Domain Analysis Transmission Lines etc In this book we lay out the foundations introducing fundamental principles definitions and formulas which are necessary for the understanding of more advanced topics The material is presented in a clear understandable format while the characteristic examples and problems accompanied by their solution contribute immensely to a thorough comprehension of the related material   *Applied Mathematics in Ferroelectricity and Piezoelectricity* Kenji Uchino,2023-12-29 This textbook Applied Mathematics in Ferroelectricity and Piezoelectricity was authored to provide the reader solid mathematical background for studying ferroelectricity and piezoelectricity as a supplemental reference to my three course books Ferroelectric Devices 2nd Edition 2010 Micromechatronics 2nd Edition 2019 and FEM and Micromechatronics with ATILA Software 2008 all published from CRC Press Physics prefers simplicity converting a complicated phenomenon expressed by a function   **Special Functions and Analysis of Differential Equations** Praveen Agarwal,Ravi P Agarwal,Michael Ruzhansky,2020-09-08 Differential Equations are very important tools in Mathematical Analysis They are widely found in mathematics itself and in its applications to statistics computing electrical circuit analysis dynamical systems economics biology and so on Recently there has been an increasing interest in and widely extended use of differential equations and systems of fractional order that is of arbitrary order as better models of phenomena in various physics engineering automatization biology and biomedicine chemistry earth science economics nature and so on Now new unified presentation and extensive development of special functions associated with fractional calculus are necessary tools being related to the theory of differentiation and integration of arbitrary order i e fractional calculus and to the fractional order or multi order differential and integral equations This book provides learners with the opportunity to develop an understanding of advancements of special functions and the skills needed to apply advanced mathematical techniques to solve complex differential equations and Partial Differential Equations PDEs Subject matters should be strongly

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