

Book Review  
Fundamentals of Electric Circuits  
by Charles K. Alexander and Matthew N. O. Sadiku  
(McGraw Hill, 4<sup>th</sup> edition, 2009)

---

Sarhan M. Musa

College of Engineering, Prairie View A&M University Networking  
Academy (PVNA), Texas, 77446, USA

*(Editor's Note: This book review is for educational and informational purposes only. Any findings and opinions, implicitly and or explicitly, implied and or stated here otherwise, are those of the author(s) and do not necessarily reflect those of the Technology Interface Journal editors, their associates, affiliates, and partners).*

Today, circuit analysis is one of the most and first fundamental courses that engineering and technology students explore in electrical engineering curriculum. There are several books that have been written on circuit analysis, but still many students find the course hard to learn. This is possibly the major explanation for publishing new circuit books and for the revised editions where ambiguities of previous editions are clarified.

The new edition of the electric circuit book by Alexander and Sadiku has developed new features of skills that can help the students for future designing process in their careers. In fact, the new addition included new 121 design problems and added new design problems at the end of the chapters. For example, the book includes new creative problems that can train the students in solving new design problems and improve their better understanding of the basic of electric circuit theory.

The text integrates the importance of historical frontiers that contribute to the field of electrical engineering which meant to confirm that electric circuits are the outcome of real invention such as space explorations. The book chapters give thought about possible careers available to graduate electrical engineering students such as electronic, instrumentation, control systems, and electromagnetics. This book also encourages students to realize the importance of good communication skills, and the text provides biological sketches of engineering pioneers such as Faraday, Ampere, Edison, and Bell.

In three parts with nineteen chapters, the book covers the basic concepts of circuits, basic laws of circuits, methods of analysis, circuit theorems, the operational amplifiers, capacitance and inductors, first-order circuits, second-order circuits, sinusoids and phasors, sinusoidal steady-state analysis, the AC power analysis, three-phase circuits, magnetically coupled circuits, frequency response, introduction to the Laplace transform, applications of the Laplace transform, the Fourier series, Fourier transform, and two-port networks. This comprehensive coverage meets the needs of diverse curricula in electrical engineering; the instructor can decide which chapter to choose for DC and AC sequence courses. The book also has several appendices on simultaneous equations and matrix inversion, complex number, and mathematical formulas. The book introduces the students through programming software that are integrated throughout the text book by using appendices—for PSpice for windows, MATLAB, and KCIDE for circuits which is developed by NASA. The book provides answers to all odd-number problems in an appendix.

The book is in its fourth edition, which is an improvement of previous editions and assist the students by presenting circuit analysis in a manner that is more clear, more interesting, and easier to understand than the other textbooks.

Chapter 1 covers basic concepts that DC circuits are based on such as current, voltage, and power. This chapter introduces six-step method for solving circuit problems that is used in the book. Chapter 2 introduces basic laws required to determine the values of the electric circuit parameters and provides techniques that can be used in circuit design and analysis such as combining resistors in series or parallel, voltage and current divisions, and delta-to-wye and wye-to-delta transformations. Chapter 3 applies Ohm's law and Kirchhoff's laws in nodal and mesh analysis which are very useful techniques in circuit analysis. Chapter 4 introduces two common theorems used in linear electric circuit (Thevenin's and Norton's theorems). This chapter discusses the concepts of superposition, source transform, and maximum power transfer. Chapter 5 studies operational amplifier circuits and presents how to use op amp in digital-to-analog converters and instrumentation amplifiers. Chapter 6 introduces capacitors and inductors combined in series and parallel, and it explores how capacitors are combined with op amp to form differentiators, integrators, and analog computers. Chapter 7 examines the analysis of first order circuits RC and RL using differential equations and their applications in delay and relay circuits, a photoflash unit, and an automobile ignition circuit. Chapter 8 considers second order RLC circuits that contain differential equations with second derivative and considers dependent and DC independent sources in the circuits. The chapter presents the initial conditions for the circuit variables and their derivatives, and it discusses series and parallel RLC circuits for initial conditions of the energy storage elements and by step inputs.

Chapter 9 is for AC circuits, sinusoids and phasors; it also introduces the concepts of impedance and admittance and applies the basic circuit laws and Kirchhoff's and Ohm's laws to AC circuits. This chapter also introduces the applications of AC circuit in phase-shifters and bridges. Chapter 10 introduces sinusoidal steady-state analysis through the learning of how to obtain steady-state response of circuits to sinusoidal inputs using phasors. This chapter shows how to use nodal analysis, mesh analysis, Thevenin's theorem, superposition, and source transformations in analyzing AC circuits. Chapter 11 introduces AC power analysis through the learning of instantaneous power and average power. Chapter 12 deals with three-phase circuits; it begins with balanced three-phase voltages, and then discusses the analysis of unbalanced three-phase systems. The developed concepts in this chapter are applied to three-phase power measurement and residential electrical wiring. Chapter 13 introduces magnetically coupled circuits through learning mutual inductance and dot convention used for finding voltages polarities, then shows transformers and their applications such as isolating and matching devices and their use in power distribution. Chapter 14 considers frequency response of electric circuits, and then introduces Bode plots. The chapter considers series and parallel resonant circuits and discusses useful quantities such as resonance, quality factor, cutoff frequency, and bandwidth. The chapter also discusses different kinds of filters and network scaling with some applications. Chapter 15 through 19 focuses on advanced circuit analysis.

Chapter 15 gives introduction to Laplace transform. Chapter 16 introduces the concept of modeling circuits in the s-domain to solve linear circuits. The chapter examines the Laplace transform when it used in network stability analysis and in network synthesis. Chapter 17 introduces trigonometric Fourier series, exponential Fourier series, and then applies the Fourier series to circuit analysis. The chapter demonstrates practical applications of Fourier series in spectrum analyzers and filters. Chapter 18 uses Fourier series in defining Fourier transform, and then the chapter applies the Fourier transform in analyzing circuits. The chapter discusses

Parseval's theorem, compares the Laplace and Fourier transforms, and then applies Fourier transform to amplitude modulation and sampling. Finally, chapter 19 introduces the concept of two-port network. It shows the relationship between electrical parameters and how two-port networks can be connected in series, parallel, or cascade circuits. It also studies the analysis of transistor circuits and synthesis of ladder networks.

The authors did an excellent job in presenting the material of electric circuit in details. They made the definition of basic terms in a different color that increases the student's attention to learning the definitions.

Each chapter starts with an opening including discussions on skills enhancement contributing to solving problems, and career talks about other sub-discipline. Each chapter is then followed by an introduction that establishes connections between the previous chapter and the current chapter. The chapter objectives are stated next, and the chapter ends with a summary of key points and formulas.

In summary, the book by Alexander and Sadiku is very clear and strong in its applications of circuit analysis. It is one of the best circuit books that can be used in undergraduate electrical engineering courses.