

Preface

The electricity and electrical networks are used now in so many fields of science and engineering practice that the further development of theoretical background and practical applications of electrical networks is necessary. The recently used network (circuits) theory and methodology of linear network system analysis and solution are based, mainly, on rather simple mathematical models. The majority of textbooks, handbooks, and lecturing materials concerning electrical network systems, which are used in a high- and medium-level technological universities and technical schools, are outdated. Nowadays the electricity supply utilities have serious problems concerning security, economy, ecology, etc., e.g. power systems have serious problems with development of high voltage networks and building new power stations. This book is needed which is widening the mathematical background (network theory), not so much as to be difficult to the readers, but useful as a tool for the new practical applications. This book presents a modern and non-conventional network theory and its practical applications in network analysis and solution. In the first part of this book, an advanced mathematical (linear algebra) approach to the modeling of time-constant networks is given. The algebraic model of network system topology is defined, and topological equations are derived and expressed in the form of a linear space. It was shown that modeling network graph in terms of linear algebra leads to the non-singular topological transformation matrix T , which appears to be a useful tool of network analysis and solution. The algebraic models of the Kirchhoff's current and voltage laws and of the Ohm's law are derived and expressed in the form of linear spaces. It makes possible the derivation of various, commonly not known, equations, which are widening the methodology of network analysis. The combined current-voltage vector is defined, and it leads to the unexpected result; it was proved that the summation of current and voltage values is reasonable from the mathematical viewpoint. Using the algebraic models of currents and voltages, the generally not known mathematical formulations of fundamental Kirchhoff's laws are derived and discussed. The classical Ohm's law is supplemented by introducing the system parameters, which enable using the current and voltage sources in network system.

In the second part of this book, using the algebraic network model, the various applications of this model are presented. The connection between theory and practical network problems is shown by solving the selected examples of network problems in which the variety of input data, solvability conditions, not known solution method, computation efficiency etc., are to be taken into account. The general algebraic model of network solution (generalization of classical method) is presented which may be applied to variety of technical and non-technical fields. Particularly, some examples of practical applications in the field of power system network analysis and solution are given. The usefulness of the new formulations of Kirchhoff's and Ohm's laws is shown using simple examples of network. The solution method of the arbitrary input data problems is given using algebraic network model. Using topological matrix T , the equations of network system analysis and solution are derived and discussed. The not known solution methods of load flow in power system network are derived and illustrated using the example of real network.

The text of this book includes the mathematical derivations and formulas, but it is understandable for engineers and students. Mathematically, more difficult parts, e.g., linear space terminology, are illustrated and described in a way understandable for non-mathematicians. The book level and contents are addressed to researchers, university lecturers, software developers, and advanced undergraduate and post-graduate students involved in power system network analysis and network development.

Warsaw, Poland

Andrzej Kłos

Mathematical Models of Electrical Network Systems
Theory and Applications - An Introduction

Klos, A.

2017, IX, 105 p. 15 illus., Hardcover

ISBN: 978-3-319-52176-3