

Ján Vlnka - Jozefa Červeňová

**Collection of Solved Examples in
Theoretical Electrical
Engineering
for Students of Mechanical
Engineering**

Single-phase circuits

2021

Acknowledgement

The article was supported by KEGA Project no. 027STU-4/2019 with the name Preparation of an accredited study program "Production Systems and Quality Management" on EUR-ACE accredited study

© Assoc.prof. Ing. Ján Vlnka, PhD. and Assoc. prof. Ing. Jozefa Červeňová, PhD.

Publisher: RAM – Verlag, Germany 2021

Lectors:

Prof. Ing. Ivan Kneppo, DrSc.

Doc. Ing. Ján Dudáš, DrSc.

Prof. Ing. Ivan Makovíny, CSc.

Prof. Ing. Dušan Hrubý, CSc.

Proofreading: Kevin Slavin, B.A. (Hons)

Cover design by: Mgr. Elena Šubjaková

Pictures drawn by: Assoc. prof. Ing. Jozefa Červeňová, PhD.

Correction and comments to: jan.vlnka@stuba.sk

Publisher:

RAM-Verlag

Stüttinghauser Ringstr. 44

D-58515 Lüdenscheid

Germany

RAM-Verlag@t-online.de

<http://ram-verlag.eu>

The publisher cannot be held responsible for any linguistic errors in book:

Such responsibility is only up to the authors.

ISBN 978-3-96595-010-8

FOREWORD

The publication is intended for students of Faculty of Mechanical Engineering of Slovak University of Technology in Bratislava, ERASMUS students, for the internationalization of education and science in Slovakia, for academic mobility, within the Central European exchange program for university studies CEEPUS and for general public. The publication complements the theoretical knowledge from lectures, deepens and practically shows the knowledge gained in lectures but also by studying the solution of practical tasks that are in line with the focus on the new accreditation program, for students giving comprehensive instructions for solving single-phase circuits. The publication consists of theoretical introduction and solved examples with circuit schemes and the solution of phasor diagrams. The publication presents typical tasks given to students of civil engineering in exams from the former Department of Electrical Engineering, founded in 1962. The publication is, among other things, a tribute to the founder of the Department of Electrical Engineering, Assoc. prof. Eng. Ivan Puzjak, PhD. on the occasion of his un-dead 92 birthday.

It is our kind duty to thank all those who have helped us with their experience and advice in preparation, and we thank our opponents for their valuable comments. At the same time, we thank the KEGA project for their support.

We believe that the publication will help listeners and general public to cope with the issue of single-phase currents and will be a good aid in the study.

In Bratislava, July 2021

Authors

Contents

| | |
|---|------------|
| INTRODUCTION | 1 |
| 1 ALGEBRA | 2 |
| 1.1 Complex numbers | 2 |
| 2. DC CIRCUITS SOLUTION | 7 |
| 2.1 Topographic analysis | 7 |
| 2.1.1 Solution by Kirchhoff's law equations | 12 |
| 2.1.2 Solution by superposition principle | 13 |
| 2.1.3 Loop current method | 14 |
| 2.1.4 Thevenin's theorem | 15 |
| 2.1.5 Norton's theorem | 18 |
| 3. TRANSFIGURATION | 22 |
| 4. SOLUTION OF SINGLE PHASE CURRENTS | 24 |
| 4.1 RR circuits | 24 |
| 4.2 RC circuits | 26 |
| 4.3 RL circuits | 47 |
| 4.4 RLC circuits | 84 |
| 5. SOLUTION OF MORE COMPLEX SINGLE PHASE CIRCUITS | 147 |
| 5.1 Solution of RC circuits | 154 |
| 6 SOLUTION OF MORE COMPLEX CIRCUITS | 171 |
| 6.1 Method of Transfiguration in AC Circuits | 171 |
| 6.2 Solution of AC circuits using Kirchhoff's circuit law | 172 |
| 6.3 Solution of AC circuits by superposition method | 173 |
| 6.4 Solution of AC circuits by loop current method | 175 |
| 6.5 Solution of AC circuits by node voltage method | 177 |

INTRODUCTION

The task and goal of this collection of solved examples from theoretical electrical engineering for engineers is to explain to students selected states of theoretical electrical engineering, specifically single-phase circuits, and to develop the ability to apply solutions to theoretical electrical engineering and to be a guide to solving these problems. The collection of solved examples is intended not only for students of the basic bachelor's study, but also for application in subjects in master's study, or in doctoral study.

Bratislava 2021

Authors