Preface

Electrical engineering plays an important role in modernizing human life and encompasses wide areas such as: generation, transmission, and distribution of electrical power, digital systems, satellite communications, signal processing, robotics, mechatronics, computer, control, artificial intelligence, and networks.

A 4 year electrical and electronic engineering curriculum normally contains two modules of electromagnetic field theories during the first 2 years. However, some curricula do not have enough slots to accommodate the two modules. This book, *Electromagnetic Field Theories*, is designed for electrical and electronic engineering undergraduate students to provide fundamental knowledge of electromagnetic fields and waves in a structured manner. A comprehensive fundamental knowledge of electric and magnetic fields is required to understand the working principles of generators, motors, and transformers. This knowledge is also necessary to analyze transmission lines, substations, insulator flashover mechanism, transient phenomena, etc.

This book is written in a simple way so that the students will find it easy to understand the electromagnetic field theory and its application in electrical engineering. Several worked out examples are included to enhance the understanding of electromagnetic field theories. Each chapter also includes several practice problems with answers given at the end of the book, which would facilitate students' understanding.

The basic parameters in electromagnetic fields are discussed in Chap. 1, while vector calculus and orthogonal coordinate systems are explained in Chap. 2. In Chap. 3, the basics of electrostatics, Coulomb's law, electric field intensity, Gauss' law, Ohm's law, and energy have been discussed. Poisson's and Laplace's equations, uniqueness theorem, and their analysis on geometric shapes have been introduced in Chap. 4. The current and its density, resistance, capacitance, continuity equation, etc., have been discussed in Chap. 5. Chapter 6 explains Lorentz's force, magnetic flux density, Biot–Savart law, Ampere's circuital law, vector magnetic potential, air gap, and series and parallel magnetic circuit. Faraday's law, conduction current, displacement current, Maxwell's equation, and basics of transformer, have been discussed in Chap. 7. Chapter 8 deals with transmission line equations, velocity of wave propagation, wavelengths, lossless propagation, distortionless transmission line, power, and Smith chart. Plane waves and its analysis are included in Chap. 9, and basics of antenna have been discussed in Chap. 10.

Features

Several textbooks on electromagnetic theories already exist in the market. However, the book on Electromagnetic Field Theories for Engineering is written for electrical and electronic engineering students with the following key features.

- Easy and logical presentation of each article
- Interpretation of each theory with proper mathematical expressions
- Emphasis on engineering mathematics to understand electromagnetic field theories
- Detailed description of fundamental laws of electromagnetic field theories
- Step-by-step problem solving procedures
- Inclusion of solved examples and practice problems
- Large number of exercise problems at the end of each chapter
- Inclusion of answers to practice and exercise problems

Aids for Instructors

The solution manual will be provided to instructors who will adopt this as a textbook, and they may obtain the solution manual by directly contacting the publishers.

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