

# Microwave Engineering

A.R. Đorđević and D.V. Tošić, *Microwave Engineering*, Academic Mind, Belgrade, 2006 (in Serbian).

This textbook is prepared for the Microwave Engineering course, which is taught at the third or fourth year (at the bachelor level) at the School of Electrical Engineering, University of Belgrade. The course has 3 hours of lectures, 1 hour of recitations, and 1 hour of lab per week, during 15 weeks of a semester. Prerequisite for the course is the Electromagnetic Field course

The textbook is a standalone and self-contained book at introductory level, targeted at communications engineering curricula. The book covers various topics of microwave theory and techniques, including the analysis of guided-wave propagation, Smith chart, classical and planar transmission lines, metallic waveguides, ferrites, scattering parameters, microwave electronic components, and antennas in their practical aspects.

Major titles in the textbooks are as follows:

1. Introduction
  - 1.1. Microwave frequency bands
  - 1.2. Applications of microwaves
  - 1.3. Specific features of microwaves
  - 1.4. Modern microwaves
2. General properties of guided electromagnetic waves
  - 2.1. Introduction
  - 2.2. Lossless guiding structures
    - 2.2.1. TEM waves
    - 2.2.2. TE, TM, and hybrid waves
  - 2.3. Wavelength; phase and group velocity
  - 2.4. Average power, losses, and attenuation coefficient
  - 2.5. Guiding systems with inhomogeneous dielectrics
3. TEM waves on transmission lines
  - 3.1. Introduction
  - 3.2. Current and voltage on two-conductor line
  - 3.3. Telegraphers' equations
  - 3.4. Standing waves
  - 3.5. Smith chart
  - 3.6. Equations for multiconductor lines
  - 3.7. Matching circuits
  - 3.8. Characteristics of some two-conductor lines with TEM waves
    - 3.8.1. Symmetrical two-wire line
    - 3.8.2. Shielded two-wire line
    - 3.8.3. Coaxial line
4. Planar transmission lines
  - 4.1. Introduction
  - 4.2. Basics of quasi-TEM analysis of lines with inhomogeneous dielectrics
  - 4.3. Substrates for planar lines
  - 4.4. Characteristics of planar lines
5. Rectangular waveguide
  - 5.1. Introduction
  - 5.2. TE and TM waves in rectangular waveguide
    - 5.2.1. TE waves
    - 5.2.2. TM waves
  - 5.3. Power and attenuation coefficient
  - 5.4. Waveguide components
6. Circular waveguide
  - 6.1. Introduction
  - 6.2. TE and TM waves
    - 6.2.1. TE waves
    - 6.2.2. TM waves
  - 6.3. Power and attenuation coefficient
  - 6.4. Waveguide components
  - 6.5. Higher-order modes in coaxial line
7. Resonators

8. Matrix parameters of microwave networks
  - 8.1. Introductions
  - 8.2. Wave intensities
  - 8.3. Scattering parameters
  - 8.4. Transmission parameters
  - 8.5. Some properties of s-parameters
  - 8.6. S-parameters of single-port networks
  - 8.7. S- parameters of two-port networks
  - 8.8. S- parameters of three-port networks
  - 8.9. S- parameters of four-port networks
  - 8.10. Matrix parameters of networks with independent generators
9. Ferrite microwave components
  - 9.1. Introduction
  - 9.2. Premagnetized ferrites
  - 9.3. Propagation of electromagnetic waves in ferrites
  - 9.4. Ferrite components
    - 9.4.1. Isolators
    - 9.4.2. Circulators
    - 9.4.3. Phase shifters
    - 9.4.4. YIG filters
10. Microwave semiconductors
  - 10.1. PIN diode
  - 10.2. Point-contact diodes and Schottky diodes
  - 10.3. Step-recovery diodes
  - 10.4. Varactor diodes
  - 10.5. Tunnel diodes
  - 10.6. Gunn diodes
  - 10.7. IMPATT diodes
  - 10.8. Transistors
    - 10.8.1. Field-effect transistors
    - 10.8.2. Bipolar transistors
  - 10.9. Microwave integrated circuits
11. Microwave tubes
  - 11.1. Microwave triodes
  - 11.2. Klystrons
  - 11.3. Magnetrons
  - 11.4. Traveling-wave tubes
12. Antennas
  - 12.1. Introduction
  - 12.2. Basic equations for radiated fields
  - 12.3. Hertz dipole
  - 12.4. Transmitting antenna
    - 12.4.1. Radiation pattern, directivity, and gain
    - 12.4.2. Antenna above conducting plane
  - 12.5. Receiving antenna
    - 12.5.1. Effective area
    - 12.5.2. Friis formula
    - 12.5.3. Radar range
  - 12.6. Examples of antennas
    - 12.6.1. Symmetrical dipole
    - 12.6.2. Vertical monopole
    - 12.6.3. Loop antenna
    - 12.6.4. Antenna arrays
    - 12.6.5. Log-periodic dipole array
    - 12.6.6. Yagi antenna
    - 12.6.7. Helicoidal antenna
    - 12.6.8. Radiating slots
    - 12.6.9. Microstrip antennas
    - 12.6.10. Horn antennas
    - 12.6.11. Reflector antennas