

# Microwave Engineering

Programme course

6 credits

Mikrovågsteknik

TNE071

Valid from: 2017 Spring semester

**Determined by**

Board of Studies for Electrical  
Engineering, Physics and Mathematics

**Date determined**

2017-01-25

## Main field of study

Electrical Engineering

## Course level

Second cycle

## Advancement level

A1X

## Course offered for

- Electronics Design Engineering, M Sc in Engineering
- Communication Systems, Master's programme
- Electronics Engineering, Master's programme
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

## Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

## Prerequisites

Electromagnetism, RF Electronics, RF System Design

## Intended learning outcomes

The aim of the course is to provide a through coverage of fundamental principles of microwave engineering with focus on wireless communication system and high-speed data transmission. Besides enhancing general radio frequency circuit theory covered in previous courses, it introduces the fundamental of microwave circuit analysis and design, from electromagnetic theory to radar systems. Starting with a concise presentation of the electromagnetic theory, the course leads to passive and active microwave circuit design supported by complex Electronic Design Automation (EDA) software for high-frequency systems. After passing the course the student should know:

- Maxwell's and Helmholtz's equations, wave solutions, TEM, TE and TM wave propagation modes, and account for the relevant propagation modes for transmission lines
- Describe the concept of plane waves in different transmission media, polarized plane waves and plane wave reflection in mathematical form
- Compare the electromagnetic theory with transmission line theory in order to describe transmission lines from the point of view of either field theory or the circuit model
- Calculate the characteristic parameters of a rectangular waveguide
- Use Smith Chart to design matching networks
- Understand different concepts of impedance matching, i.e., narrow- and broadband impedance matching
- Describe, analyse and design basic passive and active microwave circuits such as couplers, amplifiers, mixers, oscillators
- Describe, analyse on system level different radarsystem, e.g., Doppler radar.
- Use radar equation, understand radar parameters and describe different modern radar applications.
- Carry out the design of microwave circuits using advanced simulation tools, including electromagnetic simulations

## Course content

Electromagnetic theory, transmission line theory, transmission lines and waveguides, impedance matching and tuning, microwave resonators, power dividers and couplers, microwave oscillators and frequency multipliers, radar and radiometer systems.

## Teaching and working methods

Lectures, classes and laboratory exercises. Laboratory sessions are compulsory. Written laboratory work in form of an unitary project report.

## Examination

LAB1 Laboratory work with oral and written presentation	1.5 credits U, G
TEN1 Written examination	4.5 credits U, 3, 4, 5

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Department

Institutionen för teknik och naturvetenskap

## Director of Studies or equivalent

Adriana Serban

## Examiner

Adriana Serban

## Course website and other links

<http://www2.itn.liu.se/utbildning/kurs/>

## Education components

Preliminary scheduled hours: 50 h

Recommended self-study hours: 110 h

## Course literature

David M. Pozar, Microwave Engineering, Wiley & Sons 2005, ISBN 0-471-44878-8.

Vetenskapliga artiklar används också som kurslitteratur för att aktualisera kursens innehåll och sprida forskningsresultat.

## Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at [http://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).