



## HÖGSKOLAN I GÄVLE

### Elements of Microwave Engineering 7.5 cr

*Principer för mikrovågsteknik 7,5 hp*

Set by Faculty of Engineering and Sustainable Development

**Version**

**Set at**

**Valid from**

10/11/13

**HT2014**

<b>Level</b>	A1F
<b>Education level</b>	Second cycle
<b>Course identifier</b>	EEA000
<b>Credits</b>	7.5 cr
<b>Main field of study</b>	Electronics
<b>Subject group</b>	Electronics
<b>Disciplinary domain</b>	Technology 100.0 %

**Learning outcomes**

The aim of the course is to give the student basic knowledge of transmission lines, microwave components and the electromagnetic theory behind their operation. Emphasis is placed mainly on the electromagnetic aspects important for design of microwave components. The course includes practical laboratory exercises involving the use of both computerized industry-standard design tools and standard RF measurement instrumentation.

After completion of the course the student shall be able to

1. describe common microwave components and the electromagnetic theory behind their operation
2. show understanding for how transmission lines and waveguides are involved in microwave networks
3. describe, analyze, and design passive microwave devices
4. show understanding and describe microwave resonators
5. show understanding and describe microwave filters.

**Course content**

Introduction: Frequency bands in the electromagnetic spectrum, microwaves and millimeter waves, Safety (Specific Absorption Rate)  
Transmission lines and waveguides. Rectangular and circular waveguides (TEM, TE and TM modes). Planar waveguides (microstrip, stripline)

Microwave network analysis. Equivalent voltages and currents, N-port microwave networks, impedance and admittance matrices, scattering matrix, generalized scattering parameters, lossless networks, reciprocal networks  
 Impedance matching. Matching with L networks, single- and double-stub tuning, quarter-wave transformer  
 Microwave resonators. Series and parallel resonant circuits, transmission line resonators, rectangular and circular waveguide cavities  
 Microwave filters. Filter design by the insertion loss method, filter transformation, filter implementation

**Teaching** The education is performed as lectures, exercises, and laboratory work. The laboratory work is normally performed in groups of two students. Emphasis is put on the student's capability of accomplishing and reporting the work.  
 The lectures and exercises are not mandatory for the student. However, participation in laboratory work and assignment tasks is mandatory.  
 Laboratory exercises:  
 172E Wave guides  
 174E Stub matching  
 179E Design and manufacturing of a RF filter

**Prerequisites** RF Measurement Technology 7.5 cr and Electromagnetic Fields and Waves 7.5 cr or equivalent.

**Examination** Written examination and laboratory exercises.

**Grade** A, B, C, D, E, Fx, F

**Limitations** A written examination is offered at the end of the course. For each course two examination opportunities are offered: one at the end of the course and one extra.  
 Laboratory reports are due not later than a week after the scheduled occasion of the task if otherwise is not announced. Late reports are not considered until the next time the course is given (normally a year later). The report is marked by approval through the signature of the laboratory supervisor. In case of rejection, the report has to be revised by the student in agreement with the supervisors comments.

**Other regulations** Criteria for final grade will be given at the beginning of the course.

**Sustainable environment** A minor part of the course content deals with sustainable development.

<b>Module</b>	0010	Written examination	6 cr	Grade: AF
	0020	Laboratory Exercises	1.5 cr	Grade: AF