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# CIRCUITS AT HIGH FREQUENCIES (CHF)

## 0. General Information

A. Sešek  
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### General Information

General announcements:

1. Lecturer: Doc. Dr. Aleksander Sešek

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2. Asistent: Matevž Kunaver

e-mail: [matevz.kunaver@fe.uni-lj.si](mailto:matevz.kunaver@fe.uni-lj.si), ( Room BN316, tel.: (1) 4768 854)

3. Web-page: [mf.fe.uni-lj.si](http://mf.fe.uni-lj.si)

Here you will get

Slides,  
Some solved problems,  
Lab. instructions,  
All important info,

4. Web – page : [e.fe.uni-lj.si](http://e.fe.uni-lj.si)

Lab. starts on Oct. 24<sup>th</sup> in single group in LEV: from 8 am to 12 am

Later on there will be 2 groups:

Group 1, Nov 7<sup>th</sup>, from 8:00 to 10:00

Group 2, Nov 7<sup>th</sup>: from 10:00 to 12:00

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### Time usage:

- Lectures (60%): 3 hours per week (formal lectures + exercises)
- Lab work (30%): 2 hours per week  
(exercises, labs with use of CAD tools)
- Homework and the seminar 10%

### Conditions and weights:

- Lab. Work and assignments: 30% (obligatory)
- Homework: 10%
  - Correct, on time 100%
  - Correct after the time-limit: 50%
  - Incorrect: 0%
- Written and oral exam: 60%
  - Homework can be exchange for more thorough oral exam

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- Exams:
  - There will be two intermediate exams (not obligatory) – if possible
  - There will be final written and/or oral exam (obligatory)
- Conditions at the exam :
  - Lecture notes **are allowed** on written and oral exams
  - A) Conditions for final written exam:
    - Finished all laboratory assignments (with positive grades)
    - Final written exam can be skipped if:
      - all laboratory assignments are finished,
      - the grades of all intermediate exams are positive ( $\geq 60\%$ )
  - B) Conditions for final oral exam:
    - either more than 50% on final written exam
    - or more than 60% on intermediate exams.

## General Information

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### Previous knowledge:

There will be informal discussion / questionnaire at the end of this lecture (not graded), to find out the knowledge of the students.

The course will be adapted according to answers.

## Overview

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### 1. Introduction

- Short history, Specters, frequency ranges, electrical dimensions...
- Technologies used for HF circuits, HF circuits now and in the future.

### 2. HF systems and their main HF building blocks:

- Communication systems (general block diagram, WLAN, GSM...),
- Radar systems, GPS, Industrial systems (sensors,...)
- Biomedical systems (CTI),
- Research (NMR),
- Most important HF modules and components
- Most important system level parameters

### 3. Background material:

- Lines: Telegraph equations, time and frequency domain solution, lossless and loss line, standing waves,...
- Abstract models: Y, Z, S, ABCD and X parameters, Smith diagram, tuning
- Spice model and CAD in relation to lines

## Overview

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### 3. Basic modules of high frequency circuits

- Important parameters: linearity, distortions, compression, intermodulation, IIP3 (third order intercept point), Noise, Noise spectrum, Noise figure, Dynamic range, Sensitivity, Noise measurements, phase noise,
- Passive elements: R,L,C, Lines,
- Impedance transformations, matching, linear and nonlinear circuits for small and large signal,
- S parameters (and X parameters)
- Signal flow graphs
- HF active elements
- **Modeling, simulations and design of passive and active circuits,**
- **Design of basic modules: LNA, general amplifiers, mixers, oscillators, power amplifiers,**
- **CAD design tools**
- Some notes on HF digital integrated circuits
- **Some Measurements of HF circuits and systems**

### 4. THz sensors and systems

### 5. Basics of EMC

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## Overview: goals

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### To learn:

- The behavior of passive and active circuit elements at HF
- The principles of CAD design of HF circuits
- **Some measurements** of HF circuits
- Basic concepts of EMC (reduce the emissions and sensitivity)

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## Literature

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### ANG

1. M. Steer, „Microwave and RF Design: A System Approach,“ Scitech Publishing, 2013
2. D. M. Pozar, Microwave engineering, Willey, 2012.
3. S. Vionigescu, „High frequency integrated circuits,“ Cambridge University press 2013
4. M.N., Sadiku, Elements of Electromagnetics, Oxford University press, 2007
5. G. B. Roberto Sorentino, Microwave and RF Engineering, New York: Wiley, 2010.
6. B. Razavi, RF microelectronics, New York: Pearson international, 2012.
7. R. C. Paul, Electromagnetic compatibility, Wiley, 1992.

SLO <http://antena.fe.uni-lj.si/gradiva/>

1. M. Vidmar, Elektrodinamika, Založba FE, 2020
2. M. Vidmar, Antene in razširjanje valov, 2020
3. M. Vidmar, Visokofrekvenčna tehnika (lab. Vaje), 2017
4. D. Kostevc, Poglavlja iz mikrovalov, Založba FE in FRI, Ljubljana, 2005