TNE088 RF Electronics – Course information

Summary

The course consists of lectures, classes, and labs, as described below. Lisam is used to distribute lecture notes and other course specific material. Sign-up and track record for labs are done through Lisam.

1. Introduction

Many electronics applications have entered into the GHz frequency spectrum. As a consequence, it will be impossible to deal with high frequency electronics in the future if one has no knowledge of radio frequency (RF) principles. This course is intended to give electronic engineers the necessary knowledge of RF electronics. It concentrates on such topics as the fundamental theory of transmission lines, high frequency circuit behaviour, and matching networks. The course examines the difference between lumped and distributed systems. Students will learn about concepts of characteristic impedance, standing waves, reflection coefficients, and insertion loss, etc. Smith chart is introduced for graphical display of the reflection coefficient and circuit impedance, and for designing matching circuits. Single and multi-port network representation of RF circuits will be summarized with focus on both impedance/admittance-based parameters as well as wave based scattering parameter (S-parameter, T-parameter) matrices.

2. Textbook

Recommended reading. The course was originally developed using "RF Circuit Design - Theory and Applications 2nd ed., R. Ludwig et al.," as the primary textbook. The textbook has in general been very appreciated by students. However, due to availability and price the course is more and more shifting to read recommendations. Additional recommended reading is available in the document "Additional recommended reading".

There are two editions available of "RF Circuit Design - Theory and Applications"; the 2nd edition is the preferable choice. Moreover, several versions of the 2nd edition are available; softcover (also called international edition, blue and black front-page) and a hardcover version (red and black font-page). Other international re-prints intended for various regions, most common is a softcover reprint of the hardcover version with a black, dark green and grey softcover ("paperback", ISBN-10 9788131762189).

[RF Circuit Design - Theory and Applications 2nd ed., R. Ludwig et al.](),
Softcover; version: ISBN-13: 978-0-13-135505-7 (or ISBN-10: 0-13-135505-8).
Hardcover version: ISBN-13: 978-0-13-14713-7-5 (or ISBN-10: 0-13-147137-6).
- Chapters, parts included are explained in the document "Recommended reading".
- Any edition of this book is ok. You decide yourself what you get or not.

3. Formula sheet

There is a course specific formula sheet. It is based mostly on the formulas found in the text-book of the course. In addition, some general physics, math related equations have been added to make it a complete stand-alone formula sheet. The formula sheet is provided as a pdf on Lisam. It is allowed to use the formula sheet on the written exam. Print and bring it to the written exam. It is not allowed to add any text/material to the formula sheet.

4. General information, course plan and time schedule

The schedule is available (When the course period starts.) through "*TimeEdit*" (https://cloud.timeedit.net/liu/web/schema/) at the LiU homepage.
"*LISAM*" (http://lisam.liu.se) will be used as the primary course administration system.

5. Lectures

A number of lectures will be given. A preliminary list lecture topics are listed below. Lecture notes and related lecture/lab material and information can be found at "*LISAM*". The goal is to publish all slides in advance, and if late changes are made the slides will be updated after the lecture.

- Introduction to RF circuit design
- Transmission line theory and analysis I
- Transmission line theory and analysis II
- Smith Chart I
- Smith Chart II
- Single and multi-port networks
- S-parameters
- RF filter design I – Lumped implementations
- RF filter design II – Distributed implementations
- Matching networks I
- Matching networks II

6. Classes

In addition, classes are allocated to elaborate the above topics:
- Transmission line theory
- Smith Chart
- Lab introduction
- Networks- and S-parameters
- RF filter design
- Matching networks
- Two "free" classes in the end of the semester.

7. Labs

Some design and simulation labs are planned as follows:
- Transmission line simulation using Advanced Design System from Agilent (ADS)
- Transmission line measurements using Oscilloscope
- Filter design using ADS
- Design of matching networks using ADS

Examination

The examination is composed of two parts:
- 2 points (hp) for the lab course
- 4 points (hp) for the final written examination

❖ The lab part is not graded but active participation in all parts is required to pass that course part. Preparation problems are mandatory when present. Secondly it should be expected that things learnt, practiced on in the labs might very well appear in the final written exam. The final grade will be the grade acquired in the written exam.

Examiner: Magnus Karlsson