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 also done through Lisam. Two modules (Lab and Written exam) that must be completed for a completed course. The overall grade is set by the final written exam.

1. Introduction

Many electronics applications have entered the GHz frequency spectrum. Consequently, it will be impossible to deal with 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. Literature

See recommended reading in Lisam.

3. Formula sheet

There is a course specific formula sheet. In addition to RF electronics specific formulas, 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 or additions are made the slides may 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

The main purpose of the classes is to provide opportunity to practice, classes are allocated to elaborate the above topics:

- Transmission line theory
- Smith Chart
- Networks- and S-parameters
- RF filter design
- Matching networks
- Repetition class (Get ready for the written exam, and suggestions are welcomed)

7. Labs

Labs are performed in groups; preferred size is 2 students in each group. Sign-up is done through Lisam. Labs have mandatory preparation exercises. Cooperate with your lab-partner with preparations, the lab-group presents the solutions as a group, but everyone should be able to explain or repeat. Moreover, see the rules of conduct in the end. There is no lab-report.
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

8. Examination

The examination is composed of two modules:

- 2 credits (hp) for the lab course
- 4 credits (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.
- ❖ Assessment criteria are used in the course for grading. See the document "Bedömingskriterier" at Lisam for complete a description of the grade rules.
- ❖ Also see "Written exam" for more information about the written examination.

9. Rules of conduct

It is ok to use AI-tools, such as generative AI (Large language models, LLMs) to find information, aid in your learning process. However, in any examination you should solve the task yourself, and be able to explain/motivate/repeat any task/problem. You should be able to say/explain why you have done something as you have. This is extra important in labs and the preparation tasks for the labs. Retrieve knowledge, look up information, but be able to explain (prove that you have gained knowledge) why you did as you did, and where you have gotten the information from, regardless of information source. The last is extra important for theoretical answers but also valid for equations (You don't need to know the equation number or so, but you should be able to show/lookup).

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