Engineering Tripos Part IIB, 4B24: Radio Frequency Systems, 2017-18

Module Leader

Dr M J Crisp [1]

Lecturer

Dr M J Crisp

Timing and Structure

Lent term. 75% exam / 25% coursework

Prerequisites

3B1 (Assumed)

Aims

The aims of the course are to:

- Provide a system level overview of RF and Microwave, so that system performance can be predicted and optimised to meet a specification

Objectives

As specific objectives, by the end of the course students should be able to:

- Be able to apply network analysis to an RF system
- Understand the effects of noise, linearity and gain in cascaded RF systems
- Be able to optimise impedance match of an amplifier as a tradeoff of noise, linearity, bandwidth and stability
- Understand the operation of passive RF networks (Couplers, splitters, attenuators) and limits on their performance
- Have a knowledge of range of methods to improve amplifier performance
- Understand a range of RF system applications and their performance requriements

Content

It is proposed that this module will focus on the *system* aspects of RF design (as opposed to circuits). Therefore the overall aim is that circuits (amplifiers etc) can be reduced to a blocks with a minimum number of parameters from which the system performance can be estimated.

Preliminary Syllabus

1. Network Analysis

- 2-port and multi-port devices
- Impedance, Scattering and Transmission parameters, their relationships and uses

- Signal Flow Graphs
- Two port power gains

2. Noise and Distortion

- Noise sources in RF systems
- Noise figure
- Noise in passive networks
- Noise of mismatched devices
- Effects of Distortion
- Measures of distortion and intermodulation
- Dynamic range
- Noise and distortion of cascaded devices

3. Impedance Matching Methods

- Limits on achievable matches
- Distributed Impedance matching methods
- Broadband matching

4. Amplifier Design

- Stability
- Conjugate matching
- Design for low noise
- Design for high power and low distortion

5. RF System Architecture

- Zero IF
- Software Defined Radio

6. RF System Applications

- Radar
- Passive RFID
- Radio regulations

Coursework

Coursework	Format	Due date & marks
CAD Amplifier design Using industry standard software, the performance of a microwave low noise amplifier will be investigated to maximize performance. A brief getting started demonstration will be given in lectures and a drop in session organised for software trouble shooting Learning objective: • Familiarisation with microwave simulation capabilities • Design for an amplifier to meet specifications.	Individual Report anonymously marked	Weds week 9 [15/60]

Examination Guidelines

Please refer to Form & conduct of the examinations [2].

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Links
[1] mailto:mjc87@cam.ac.uk
[2] https://teaching.eng.cam.ac.uk/content/form-conduct-examinations