

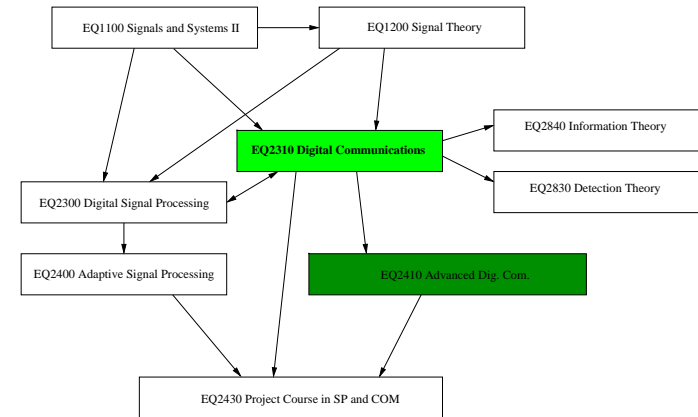
## EQ2310 DIGITAL COMMUNICATIONS

- A general introduction to the principles and methods of Digital Communications.
- 14 lectures in Period 1
- [www.s3.kth.se/signal/edu/komteori](http://www.s3.kth.se/signal/edu/komteori)

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## RELATED COURSES

Related courses given by the Communication Theory and Signal Processing Labs at the School of EE:



## LANGUAGE

*The course will be presented entirely in English.*

Since...

- ... it is part of the international Master's program in Wireless Systems.
- ... it, in addition, is taken by several international exchange students.

However...

- ... all teachers in the course speak and understand Swedish.

## COURSE STRUCTURE

### Structure

Lectures	28h	Examination	7.5 ECTS cu
Tutorials	26h	Lab and project	1.5 ETCS cu
Help Sessions	12h	Grades	ETCS
Lab Exercise	4h		
Examination	5h		

In addition a take-home project assignment

**Period 1:** Lectures, tutorials, help sessions, examination

**Period 2:** Lab exercise, project assignment

## INTENDED LEARNING OUTCOMES

To successfully pass the course, you should be able to:

- Characterize and apply basic techniques in digital comms;
- Apply mathematical modeling to basic digital comms problems;
- Perform simple experiments with a hardware platform, analyze results and report findings in writing;
- Develop and use simple software to implement basic digital comms techniques, evaluate and report results.

To acquire a higher grade, you should in addition be able to:

- Compare and judge different techniques in digital comms;
- Formulate and apply advanced mathematical models, which are applicable and relevant in the case of a given problem.

## LECTURES

- Why?
- I will mix slides with notes on the board.
  - *Slides*: Definitions, results, statements, summaries,...
  - \* *The slides will constitute a reasonably coherent but not complete description of the course...*
  - *Notes on the board*: Important results, derivations, comments to the slides (to “slow things down”), examples,...
  - \* *The board notes alone will neither be a coherent nor complete description...*
  - Alternative presentation as compared to the textbook
- The slides can be downloaded at the course homepage  
[www.s3.kth.se/signal/edu/komteori](http://www.s3.kth.se/signal/edu/komteori)

## ASSESSMENT

### Period 1:

- Five-hours written exam in two parts;
  - Part I: 80% of total marks to pass (grade E);
  - Part II is only marked if Part I is passed;
- Potential bonus marks via 2 voluntary homework assignments.

### Period 2:

- Laboratory exercise report (pass/fail);
- Technical project report (pass/fail).

## LEARNING ACTIVITIES IN CLASS

- 10 minutes quiz based on previous lecture;
  - Peer-reviewed;
- Conceptual questions during lecture;
  - Discuss in groups of 2-3 students;
  - Class discussion to reach consensus;
- “One-minute paper” or “muddy Card”
  - Answer 3 questions about the lecture presentation

## TUTORIALS AND ASSISTANCE

- **Tutorial sessions** (“övningar”): One tutorial session will follow each lecture (starting after lecture 2).
  - Problem solving demonstration in a lecture hall.
- **Assistance sessions** (“räknestugor”): One assistance session per week.
  - Two-hour sessions in an allocated class room. Problem solving assistance available throughout (including some limited assistance with solving homework problems).

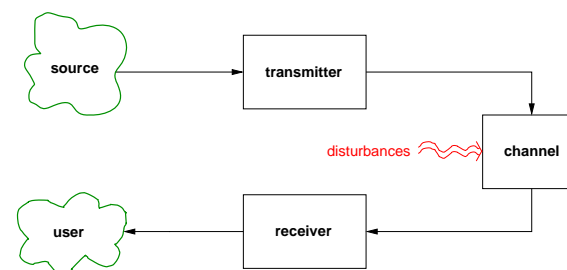
## INTRODUCTION TO (DIGITAL) COMMUNICATIONS

- **Introduction:** (Ch. 1)
  - A general (electrical) communication system
  - Channels
  - A digital communication system
  - Course outline

## TEXTBOOK

- **Main textbook**
  - U. Madhow, “Fundamentals of Digital Communications,” Cambridge Uni Press, 2008
  - (last year: Proakis & Salehi, “Digital Communications,” 5th Ed.)
  - (before then: Proakis, “Digital Communications,” 4th Ed.)
  - Will be used also in EQ2410 Adv. Digital Communications
- *7.5 credit units based on the textbook*  $\implies$  relatively demanding material to cover in period 1...
  - Lectures and tutorials define the *core course contents*

## AN ELECTRICAL COMMUNICATION SYSTEM

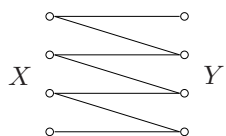


## CHANNELS

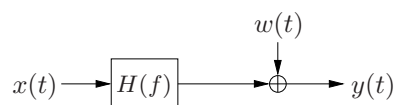
- *Physical channels*: the atmosphere, wirelines, optical fibers, computer hard disks, compact disks, . . .
- *Channel models*: We need good models of the random phenomena introduced by the physical channel!

- *Examples*:

- A discrete channel



- A linear additive noise channel



- *Strive for*: Simple and efficient model of the parts of the communication chain that *cannot be influenced* . . .

- **Modulation and Detection**: Chs 2, 3, 4

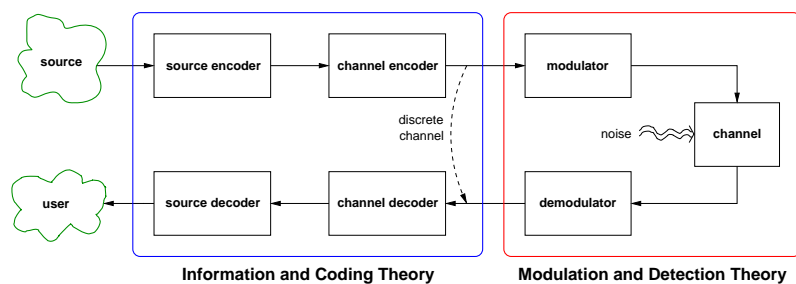
- *Modulation*: Transform digital data into an analog signal that can be transmitted or stored (the “real world” is analog, not digital) . . .

- \* Lectures 1–6

- *Demodulation/Detection*: The received signal contains information about the transmitted data but is corrupted by noise (etc.). Estimate what data was sent, aiming at minimum possible probability of making mistakes . . .

- \* Lectures 1–6

## A DIGITAL COMMUNICATION SYSTEM



- **Information and Coding Theory**: Chs 6, 7, Handouts

- **Channel capacity and coding**: Chs 6, 7

- \* Lectures 7–10

- \* *Intro. to Information theory*: Information measures, entropy, Channel capacity, limits, . . .

- \* *Channel coding*: Use clever coding (“redundant bits”) to counteract transmission errors . . .

- **Information sources and source coding**: Handouts

- \* Lectures 11–12

- \* *Source coding*: Represent source data efficiently (“few bits”) in digital form . . .

- **Applications of Digital Comms Theory:** Handouts
  - Guest lecturer from industry
  - Discuss the use of how you can use what you learn in this course in a challenging industry job situation
  - Lectures 13