**SYLLABUS**

# Measurement technology and uncertainty analysis 7.5 credits E7021E

## Mätteknik och felanalys

**Course syllabus admitted: Autumn 2012 Sp 1 - Present**

DECISION DATE
**2012-03-13**

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LULEÅ TEKNISKA UNIVERSITET

# Measurement technology and uncertainty analysis 7.5 credits E7021E

## Mätteknik och felanalys

## Second cycle, E7021E

| Education level | Grade scale | Subject | Subject group (SCB) |
| --- | --- | --- | --- |
| Second cycle | G U 3 4 5 | Elektroteknik | Electrical Engineering |

# Entry requirements

Good knowledge in mathematics (M0032M, M0018M), physics (F0004T), basic circuit theory (E0003E), and mathematical statistics (S0001M). More specifically, good understanding of mathematical analysis, linear algebra, probability density functions, expectations and variance, RLC circuits, Laplace and Fourier transforms is required.
Alternative:
Alternative to completed courses can be corresponding knowledge acquired through work within the electronics or process industry sector.

# Selection

The selection is based on 30-285 credits

# Examiner

Johan Carlson

# Course Aim

After completion of the course, the students shall have knowledge and understanding concerning:

- Fundamental physical and mathematical principles of a selection of measurement systems.
- Mathematical and statistical principles necessary for conducting a detailed uncertainty analysis of a specific measurement system, given uncertainties of the system’s components.

After completion of the course, the students shall be able to:

- Construct basic circuits for measurement of electrical quantities.
- Estimate the parameters of physical models based on measured data.
- Build empirical models of a system and estimate parameters of these.
- Evaluate models with respect to functionality, reliability, and computational complexity.
- Motivate and present the results orally and in written reports.

The students should also be able to judge:

- The possibilities and limitations of a given measurement system.

# Contents

Measurement technology is a wide area, spanning from modeling of the physical process being studied, through construction of measurement systems, parameter estimation and system identification, to a detailed analysis of data and error sources.

This course focuses primarily on the problem of modeling a process and then identifying model parameters and analysis of the results.

A major part of the course therefore deals with the analysis, since an understanding of how error sources (measurement noise, model errors, etc.) affect the system as a whole, with respect to functionality, economy, and energy efficiency.

The practical experience will be given by laborations, where both sensors and basic electronics are assembled and connected to a physical process. The theoretical analysis is then performed using MATLAB, and the results are summarized in written reports.

# Realization

Each course occasion´s language and form is stated and appear on the course page on Luleå University of Technology's website.

The teaching is divided in lectures, problem demonstrations, and practical laborations. The theoretical concepts are presented during the lectures, and in the problem demonstration sessions, the students will be given training in solving theoretical problems. The laborations will provide practical experience in constructing measurement systems and analyzing their performance, in terms of accuracy, repeatability, computational complexity, and energy efficiency.

# Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided.

Written exam with differentiated grades and successful completion of the laborations. All practical laborations must be completed to pass the course, but the grade is set by the result on the written exam.

# Transition terms

Sustainable development has been implemented in this course from automn semester 2010.

# Literature. Valid from Autumn 2009 Sp 1

John P. Bentley, Principles of Measurement Systems, 4th ed, Pearson/Prentice Hall, 2005. ISBN: 0 130 43028 5
Supplementary material will be distributed during the course.

# Course offered by

Department of Computer Science, Electrical and Space Engineering

# Items/credits

| Number | Type | Credits | Grade |
| --- | --- | --- | --- |
| 0001 | Written exam | 4.5 | G U 3 4 5 |
| 0002 | Laboratory work | 3 | U G# |

# Study guidance

Study guidance for the course is to be found in our learning platform Canvas before the course starts. Students applying for single subject courses get more information in the Welcome letter. You will find the learning platform via My LTU.

# Last revised

by Jonny Johansson, HUL SRT 2012-03-13

# Syllabus established

by the Department of Computer Science and Electrical Engineering 2008-12-15