

### 2.3.2 Instrumentation and Measurement

<b>Instrumentation and Measurement</b>
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<b>Module Summary</b>
Module code: EEIB320
Module coordinator: Prof. Dr. Manfred Litzenburger
Credits (ECTS): 7 Points
Semester: 3. Semester
Pre-requisites with regard to content: Modules Circuit Analysis I and II, Electromagnetic Fields, Mathematics I and II
Pre-requisites according to the examination regulations: Regarding to the examination regulations no pre-requisites are required
Competencies: The students are able to treat measurement tasks by <ul style="list-style-type: none"> <li>• Assessing the measurement uncertainty of a measurement chain by means of error calculation and error propagation</li> <li>• Understanding the mode of operation of electrical measurement methods</li> <li>• Using the oscilloscope as a universal measurement tool</li> <li>• Selecting and applying electrical measurement methods according to the requirements on the measurement problem</li> </ul> to gain a thorough and comprehensive understanding of measurement systems for conceiving and implementing complex measurement tasks.
Assessment: Exam, 120 minutes. Practical knowledge of dealing with measurement equipment and the laboratory experiments is checked by means of colloquia and written reports for the experiments.
Usability: This module presents methods and electronic circuits for measurement tasks which are applied e.g. in control theory, automation engineering, information processing and characterisation of electric and electronic devices.

<b>Course: Instrumentation and Measurement</b>
Module code: EEIB321
Lecturer: Prof. Dr. Manfred Litzenburger
Scope of weekly semester hours (SWS): 4
Semester of delivery: Winter semester
Type/mode: Lecture, Compulsory subject
Language of instruction: English
Content:

- physical quantities and units of measurements, international system of units
- sources of errors, measurement uncertainty, error propagation
- oscilloscope
- electromechanical meters
- measurement methods for DC voltage and current
- measurement methods for AC voltage and current
- measurement of non-electrical physical quantities, e.g. temperature
- operational amplifiers in measurement instrumentation
- digital signal acquisition, analog-to-digital- / digital-to-analog- conversion
- measurement standards and references
- electrical power measurement in AC and three-phase current
- simulation of measurement methods with LT-Spice

Recommended reading:

- Will be announced in the lectures

**Course: Instrumentation and Measurement Lab**

Module code: EEIB252

Lecturer: Prof. Dr. Manfred Litzenburger

Scope of weekly semester hours (SWS): 2

Semester of delivery: Winter semester

Type/mode: Labor, Compulsory subject

Language of instruction: English

- Content:
- Computer-based data acquisition with digital multimeter, 2-wire- and 4-wire measurement of contact resistance, statistical data analysis
  - Measurements with the digital oscilloscope, characterisation of periodic signals, FFT-analysis, chatter of switches and relays
  - Temperature sensors and measurements, thermal conduction, model-based data analysis and characterisation of thermal parameters
  - Fundamentals of operational amplifiers, measurement of characteristic parameters and basic amplifier circuits
  - Application of operational amplifiers: integrator, differentiator, precision rectifier, measuring bridge amplification with instrumentation amplifier, lock-in amplifier
  - Characterisation of AD- and DA-converters, dual slope principle, successive approximation register principle, simulations with LT-Spice

Recommended reading:

- See corresponding lecture