Course **"Electronics for Physicists"** Edition 2025, location: TU Delft

Lectures: Building 20 (Aula), Lecture Hall D [8u45-12u45]

Labs: Building 22 (TNW), Room A151 [13u45-17u30]

Lect 1. Tue 4 Nov (morning) Lecture + demo	**1: Introduction to electronics** Goal: send, receive, process information via voltage/current/charge/flux in circuits Basic components: Resistor, capacitor, inductor, diode, transistor, opamp. Concepts: feedback, circuit models and limitations. Practical basics for the afternoon lab: breadboards, soldering, equipment
Lab 1. Tue 4 Nov (afternoon**)** Lab practice	**1:** Learn how to solder (even small surface mount components on a PCB) Build a charge detector, thermocouple amplifier, curve tracer, liquid level meter Use resonant LC-circuits to transmit/receive information
Lect 2. Tue 11 Nov (morning) Lecture + demo	**2: Integrated circuits and design tools, analog and digital** Circuit simulation software tools (spice) and model-limitations. Prototyping and printed circuit boards: design, construction and build-limitations Digital electronics; logic functions, microprocessors, DSP, FPGA, development platforms
Lab 2. Tue 11 Nov (afternoon) Lab practice	**2:** Circuit simulation software: Simulate, build and measure a filter, see limitations. Make a stand-alone laser controller system using a microcontroller. Applications of development kits and FPGA/microcontrollerboards.
Lect 3. Tue 18 Nov (morning) Lecture + demo	**3: Signals, noise, interference and shielding** Description of signals, waveforms, rise time, bandwidth, slew rate, modulation Noise and interference, noise sources, interference sources, signal to noise ratio Shielding, cables, ground loop, Faraday cage
Lab 3. Tue 18 Nov (afternoon) Lab practice	**3:** Search and identify interference with simple E/H probes Measure the effect of ground currents on signals in cables Build an optical link, identify interference, measure the rise time/bandwidth Determine signal to noise, make a resonant circuit. Shielding electric and magnetic fields, impedance of grounding wires
Lect 4. Tue 25 Nov (morning) Lecture + demo	**4: RF and microwaves** Transmission lines: introduction, models, standing waves, loss Scattering parameters: RF transmission/reflection in systems, cables and on PCB RF components and specifications: mixers, noise temperature, cryogenic application
Lab 4. Tue 25 Nov (afternoon) Lab practice	**4:** Measure transmission line behavior in cables RF-applications of mixers: phase measurement, frequency doubler, demodulation Examine waveguide transmission versus coax lines Application: make a transmission line pulser
Lect 5. Tue 02 Dec (morning) Lecture + demo	**5: Measurement: sensors, front-end and techniques** Sensors/transducers sensors, actuators, components (photodetectors), circuits Front-end amplifiers: instrumentation amp, IV-converter, iso-amp, rf (cryo) amplifier Define amplifier specs for a given measurement goal and test this. Filters: types, order, limitations and applications. Measurement techniques: bridge circuits, resonant circuits homodyning/heterodyning, time domain and frequency domain reflectometry
Lab 5. Tue 02 Dec (afternoon) Lab practice	**5:** Build a capacitive bridge position sensor. Homodyning/heterodyning using mixer Build a reflectometry setup to detect cable and connector mismatch reflections. Use a Vector network Analyzer to read resonant ¼λ line, measure absorber effects Build and measure interference rejection filters
Lect 6. Tue 09 Dec (morning) Lecture + demo	**6: Measurement equipment and setup** A to D conversion: specifications, limitations, use of subsampling and oversampling Equipment: concepts, reading the spec sheet, power supply, dc-measurements, Lock-in amp, DAQ-cards, Oscilloscope, spectrum/network analyzer, TDR, function/pulse/arbitrary/microwave generator, frequency vs time domain Controlling a measurement setup
Lab 6. Tue 09 Dec (afternoon) Lab practice	**6:** Use a real lock-in amplifier, use network/spectrum analyzer on resonant structures Digital oscilloscope: functions, tools, recognize sampling aliasing problems. Build and program a basic ultra-low budget DAQ system