Electronics for physicists, 2024, location: T.U.Delft

Labs: building 22 (TNW) room A151 [8u45-12u45] **Lectures**: building 22, F005, lecture hall E [13u45-17u15]

Lect 1 tue oct 29 afternoon 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 nov 05 Morning 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 nov 05 afternoon Lecture + demo	**2: integrated circuits and design tools, analog and digital** Circuit simulation software tools (spice, microcap) and model-limitations. Prototyping and printed circuit boards (pcb) design, construction and build-limitations Digital electronics; logic functions, microprocessors, DSP, FPGA, development platforms
Lab 2 tue nov 12 Morning Lab practice	**2:** Use of circuit simulation software. Simulate, build, 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 nov 12 afternoon Lecture+demo	**3: Signals, noise, interference and shielding.** Description of signals, sine, pulse, rise time, bandwidth, slew rate, dc/ac Noise and interference, noise sources, interference sources, signal to noise ratio Shielding ,cables, ground loop, Faraday cage
Lab 3 tue nov 19 morning 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 nov 19 afternoon Lecture + demo	**4: RF and microwaves**. Transmission lines: introduction, formula's, standing waves Scattering parameters: RF transmission/reflection in systems and on PCB RF components and specifications: mixers, noise temperature, cryogenic application
Lab 4 tue nov 26 morning Lab practice	**4:** Measure transmission line behavior in cables Application: make a transmission liner pulser RF-applications of mixers : phase measurement frequency doubler, demodulation Examine waveguide transmission versus coaxlines
Lect 5 tue nov 26 afternoon 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 dec 03 morning 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 Networkanalyser to read resonant ¼λ line , measure absorber effects Build and measure interference rejection filters
Lect 6 tue dec 03 afternoon Lecture + demo	**6: Measurement equipment and setup** A to D conversion: specifications, limitations, using subsampling and oversampling Equipment:, concepts and specifications, reading the specsheet ,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 dec 10 Morning Lab practice	**6:** Use a real lock-in amplifier, Use network/spectrum analyzer on resonant structures Digital oscilloscope: functions, recognize sampling aliasing problems. Build and program a basic ultra-low budget DAQ system