ENGINEERING

Introductory Engineering

Module assigned to 1st semester

Identification Code	2288870070
ECTS-Points	5
Credit Hours	4
Language	english
Length of the Module	1 semester
Date and Capacity	winter term 60 students
Responsible Lecturer	Prof. Dr. Ferdinand Scholz
Further Lecturer	Prof. Dr. Ferdinand Scholz
Study Programme	Master degree in Advanced Materials Compulsory for students with major Nanomaterials Elective for students with major Biomaterials
Prerequisites	BSc degree
Study Objectives	Electrical Engineering: Students should be able to - perform circuit analysis of linear DC and AC (RLC) circuits - analyze transient problems of RLC circuits - understand the basics of crystal and semiconductor physics - understand how basic semiconductor devices work - understand basic treatment/evaluation of measured data - understand conversion of analogue data into digital data, basic treatment of digital data, advantages and problems of digital data processing
Module Contents	- Measurement units, SI units - Basic Electrical Engineering: Charge, voltage, current, power, energy, Kirchhoff's laws, Circuit analysis: Resistive circuits, resistances in series and parallel; network analysis by using series and parallel equivalents, voltage and current dividers, duality, node-voltage analysis, mesh current analysis, Thevenin and Norton equivalent circuits, superposition principle, linearity, Wheatstone bridge; Capacitor, inductor: capacitance, modelling of real elements, inductance, magnetic fields, magnetic circuits, magnetic materials, ideal and real transformers, Maxwell's equations - Analysis of transients: First and second order transient circuits, steady-state sinusoidal analysis: phasors, complex numbers, complex impedances, power in AC circuits, average power etc., Thevenin and Norton equivalent, maximum power transfer, Frequency analysis, filters etc.: Frequency response, logarithmic scale, Bode diagram, low pass, high pass, 2nd order low pass etc. - Fourier and Laplace transformation: Transfer function, step, pulse response, convolution - Semiconductors: Basics of crystallography: Miller's indices, reziprocal lattice, Brillouin zone, Basics of band structure: Naïve band diagram, dispersion relation, Schrödinger equation, effective mass, concept of hole, direct/indirect band structure, interaction with light, carrier statistics, density of states, Fermi statistics, impurity conduction, mobility, diffusion, Hall effect

	- Diodes: p-n-junction, ideality factor, load line analysis, fabrication, special diodes, pn as capacitance, hetero junction, Schottky diode, compound semiconductors - Transistors: Bipolar transistor, band structure, common base, common emitter, amplification, Field Effect Transistor: Structure, operation, enhancement and depletion; load line analysis - Devices for measurement: Operational amplifier: Basics, adder, subtractor, integrator, differentiator, logarithmiser, instrumentation amplifier - Basics of measurement, errors, statistics: Random and systematic errors, mean value, standard deviation, probability distributions: Binomial, Poisson, Gauss, error propagation, regression - Signal filtering, Noise : Thermal, shot, 1/f, distribution, generation-recombination, noise figure of 4-port, Signal filtering: passive, active, Lock-In, Boxcar, signal transmission - Digital Signal Processing: Binary signals, Binary numbers, Gray code, basic logic operations, adders, flip-flop, Digitization: Basics, sampling theorem, DA and AD converters, Digital filters, z-transformation, Microcomputers, microcontrollers: Building blocks, data storage, data transmission
Literature	Electrical Engineering: - Allan R. Hambley: Electrical Engineering, Prentice Hall, Upper Saddle River, 2002 - Ch. Kittel, Introduction to Solid State Physics, Wiley, New York, 1996 - H.P. Hsu. Schaum's Outlines: Signals and Systems. McGraw-Hill, New York, 1995. - S.M. Sze. Physics of Semiconductor Devices. John Wiley & sons, New York, 1981. - P. Profos and T. Pfeifer. Handbuch der industriellen Messtechnik. R. Oldenbourg, München, 1994.
Teaching Methods	Introductory Engineering (L), 3 h/week Introductory Engineering (E), 1 h/week
Estimation of working load	42 h lecture (presence) 14 h exercises, practical training (presence) 50 h preparation and postprocessing lecture 28 h solution of exercises, postprocessing 16 h exam preparation Total: 150 h
Examinations	Written exam
Grade Composition	Exam result
Usability	MSc course of studies Energy Science and Technology