Technology
Arts Sciences
TH Köln

Course Manual ME

Electrial Engineering Materials

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General information

Long name	Electrial Engineering Materials
Approving CModule	ME_BaET
Responsible	Prof. Dr.-Ing. Dirk Poggemann Professor Fakultät IME
Valid from	summer semester 2022
Level	Bachelor
Semester in the year	summer semester
Duration	Semester
Hours in self-study	60
ECTS	5
Professors	Prof. Dr.-Ing. Dirk Poggemann Professor Fakultät IME
Requirements	Basics in Mathematics Basics in Physics Basics in Electrical Engineering
Language	German, English if necessary
Separate final exam	Yes

Literature

- Hansgeorg Hofmann, Jürgen Spindler: Werkstoffe in der Elektrotechnik, Hanser - Verlag
- Ellen Ivers-Tiffée, Waldemar von Münch: Werkstoffe der Elektrotechnik, Teubner-Verlag
- Gerhard Fasching: Werkstoffe für die Elektrotechnik, Springer-Verlag
- Hanno Schaumburg: Werkstoffe, Teubner-Verlag
- James F. Shackelford: Werkstofftechnologie für Ingenieure, Pearson
- S. M. Sze, Kwok K. Ng: Physics of Semiconductor Devices, Wiley
- Frank Thuselt: Physik der Halbleiterbauelemente, Springer-Verlag
- Michael Reisch: Halbleiter-Bauelemente, Springer-Verlag

Final exam

Details	Technical discussion, students shall explain and discuss topics from the lecture. Materials shall be selected for an application on the basis of given boundary conditions and effects in electronic circuits / components shall be explained on the basis of material properties.
Minimum standard	Basics of atomic structure, periodic table and electrical conduction must be answered. A total of at least 50% of the questions must be answered correctly.
Exam Type	EN mündliche Prüfung, strukturierte Befragung

− Lecture / Exercises

Learning goals

Goal type	Description

Special requirements

none

Accompanying material	Lecture slides Videos to the slides Excercises
Separate exam	No

Knowledge	Structure of the materials - Atomic models - Electron configuration & periodic table of elements - Chemical bonds - Crystal structures Electrical Properties metals and metal alloys - Specific resistance - Electron conduction - Superconductivity Semiconductors - Definition and band structure - Fermi-Dirac distribution and density of states - Intrinsic conduction - Extrinsic conduction and Doping - Hall effect - Development- and Production-Process Dielectric materials - Overview and definition - Electric conductivity Volume resistance Surface resistance Dielectric strength - Dielectric polarization Definition Polarization mechanisms Frequency dependence of the dielectric constant Dielectric loss and its frequency dependence - Dielectric material classification Ferroelectrics Piezoelectrics Pyroelectrics Optical properties - Particle theory Description of absorption from the electronic structure - Wave theory Relationship between dielectric function and frequency dependence of optical constants Magnetic materials - Definition and classification according to magnetic behavior Dia- and Paramagnetism Ferro- and Ferrimagnetism - Atomistic model of magnetism - Magnetization and magnetic hysteresis - Loss mechanisms and loss factor

Skills	description of the structure of the atoms according to the periodic table, in particular the electron configuration Prediction of the type of chemical bonds between atoms the conduction mechanism of metals and semiconductors can be explained calculation of the specific conductivity by specifying the mobility and concentration of the charge carriers Making statements about the conductivity and optical properties of solids from the electronic band structure

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	3
Exercises (whole course)	1
Exercises (shared course)	0
Tutorial (voluntary)	0

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	In-depth study and presentation of a topic from the lecture, e.g. with supporting simulations
Skills	Research on literature presentation (simulation)

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Seminar	1
Tutorial (voluntary)	0

Special literature

wird anhand der Präsentationsthemen gegeben

Special requirements

none

Accompanying material	undefined
Separate exam	Yes

Separate exam

Exam Type	EN Fachgespräch (Interview) zu besonderen Fragestellungen (Szenario, Projektaufgabe, Lieraturrecherche)
Details	Topics for the presentations are fixed after the first 4 weeks of lectures, the topics should relate to the main areas of study. Students work on the topics and present the results (15min - 30min) in the last two weeks of the lecture, if a large number of students participates as a teamwork.
Minimum standard	Presentation shall go beyond the lecture slides and be correct.