

## Course

# ME - Electrical Engineering Materials

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### ^ General information

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

## 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

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.

# ^ Lecture / Exercises

## Learning goals

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### 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

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## 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

## Separate exam

none

## ^ Seminar

## Learning goals

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### 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

## Separate exam

### Exam Type

discussion (interview) about special issues (szenario, project assignment, literature research)

### 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.