

## Course

# EMV - Electrical safety and EMC

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### ^ General information

<b>Long name</b>	Electrical safety and EMC
<b>Approving CModule</b>	<a href="#">EMV BaET</a>
<b>Responsible</b>	Prof. Dr. Christof Humpert Professor Fakultät IME
<b>Organisation and materials</b>	<a href="#">ILU course for the Electrical safety and EMC</a>
<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. Christof Humpert Professor Fakultät IME
<b>Requirements</b>	Fundamentals of electrical engineering - Specific resistance, capacitor, inductor - Basic circuits and impedances in the AC circuit - Complex AC calculation - Three-phase system - Electric and magnetic alternating field - Dielectric and magnetic material properties
<b>Language</b>	German
<b>Separate final exam</b>	Yes

Final exam

## Details

Written examination, in some cases also oral examination, with the following elements:

- Free text answers to inquire about the necessary knowledge (hazards, typical measures, electromagnetic interference)
- Text exercises for the calculation of fault currents, touch voltages, interference voltages in known and new systems
- Text exercises for the determination and analysis of interference spectra
- Text exercises for the analysis of systems and selection and dimensioning of protection and interference suppression measures

## Minimum standard

50 % of the questions and tasks correctly solved

## Exam Type

Written examination, in some cases also oral examination, with the following elements:

- Free text answers to inquire about the necessary knowledge (hazards, typical measures, electromagnetic interference)
- Text exercises for the calculation of fault currents, touch voltages, interference voltages in known and new systems
- Text exercises for the determination and analysis of interference spectra
- Text exercises for the analysis of systems and selection and dimensioning of protection and interference suppression measures

# ^ Lecture / Exercises

## Learning goals

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### Knowledge

Electrical safety

- Effects of electrical current on the human body
- Network configurations and possible touch voltages
- Grounding, earth electrode, gradient area, step voltage
- Protective measures, protective insulation, protective equipotential bonding, safety extra-low voltage, protective separation, protective earthing, residual current circuit protection
- Protective devices, fuses, line safety switch, residual current devices

Electromagnetic compatibility

- Definitions, basic influencing model, level definition
  - Description in time and frequency domain, Fourier series, Fourier transform
  - sources of interference, differential-mode and common-mode interference, narrow-band interference sources, intermittent broadband interference sources, transient sources of interference (ESD, LEMP, SEMP, NEMP)
  - Coupling mechanisms, galvanic coupling, capacitive coupling, inductive coupling, radiation coupling
  - Interference suppression measures, electromagnetic screens, filters, lightning protection, surge arresters
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### Skills

Use protective measures

- Know hazards due to electric current
- Calculate touch voltages depending on the network configuration and the type of fault
- Select suitable protective measures according to standard
- Dimension protective measures

Analyze and evaluate interference spectra

- Assign interference spectra to typical sources of interference
- Calculate the interference spectrum using the Fourier analysis
- Determine the interference spectrum with simplified methods
- Reconstruct the time domain function from the interference spectrum
- Evaluate the effect of interference suppression measures on the basis of the interference spectrum
- Evaluate the influence on interference sink

Select and dimension interference suppression measures

- Select appropriate measures depending on the coupling mechanism
- Apply measures for differential-mode and common-mode interferences
- Select measures depending on the interference spectrum
- Dimension external lightning protection measures
- Calculate surge voltages in the case of lightning strikes
- Calculate the influence of filters

## Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Exercises (whole course)	2

## Separate exam

none

## ^ Practical training

### Learning goals

#### Knowledge

Effects and limitation of overvoltages, types of surge arresters  
 Properties and influence of electrostatic discharges  
 Frequency spectra of conducted interference voltages  
 Basics of the normative specifications

#### Skills

Understand and implement complex texts and standards  
 Use calculation tools for EMC analysis  
 Plan EMC tests, analyze and modify test setups and compare them with normative specifications  
 Investigate sources of interference experimentally, measure interference spectra, compare with calculation results

Analyze and compare the effect of interference suppression measures and explain differences

Manage complex tasks in a team

Summarize, evaluate and interpret results in written form

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## Demonstrate action competence

Independent familiarization and execution of simulations with LTspice

Investigation of mesh filters and their parasitic properties

## Expenditure classroom teaching

Type	Attendance (h/Wk.)
Practical training	1

## Separate exam

### Exam Type

working on projects assignment with your team e.g. in a lab)

### Details

Written test to control the preparation of the lab exercises

Observation of the lab exercises performed independent and feedback

Evaluation of detailed reports of the lab exercises

### Minimum standard

70 % of the written test correctly

80 % of the measurement results correct

80 % of the evaluation performed correctly

80 % of the discussion makes sense