

Course Manual EMV

Electrical safety and EMC

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– General information

Long name Electrical safety and EMC

Approving CModule [EMV BaET](#)

Responsible Prof. Dr. Christof Humpert
Professor Fakultät IME

Valid from summer semester 2023

Level Bachelor

Semester in the year summer semester

Duration Semester

Hours in self-study 60

ECTS 5

Professors Prof. Dr. Christof Humpert
Professor Fakultät IME

Requirements Fundamentals of electrical engineering
- Impedances in the AC circuit
- Complex AC calculation
- Three-phase system
- Electric and magnetic alternating field
- Dielectric and magnetic material properties

Language German

Separate final exam Yes

Literature

Schwab, Kürner; Elektromagnetische Verträglichkeit (Springer)

Gonschorek; EMV für Geräteentwickler und Systemintegratoren (Springer)

Wolfsperger; Elektromagnetische Schirmung (Springer)

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

EN Klausur

– Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	<p>Electrical safety</p> <ul style="list-style-type: none">- 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 <p>Electromagnetic compatibility</p> <ul style="list-style-type: none">- 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

Special requirements

none

Accompanying material

Electronic presentation slides for the lecture
Detailed exercise task collection with solutions
Electronic tutorials for self-study, questionnaire and task help sheets

Separate exam

No

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
Exercises (shared course)	0
Tutorial (voluntary)	0

– Practical training

Learning goals

Goal type	Description
Knowledge	<p>Effects and limitation of overvoltages, types of surge arresters</p> <p>Properties and influence of electrostatic discharges</p> <p>Frequency spectra of conducted interference voltages</p> <p>Basics of the normative specifications</p>
Skills	<p>Understand and implement complex texts and standards</p> <p>Use calculation tools for EMC analysis</p> <p>Plan EMC tests, analyze and modify test setups and compare them with normative specifications</p> <p>Investigate sources of interference experimentally, measure interference spectra, compare with calculation results</p> <p>Analyze and compare the effect of interference suppression measures and explain differences</p> <p>Manage complex tasks in a team</p> <p>Summarize, evaluate and interpret results in written form</p>

Expenditure classroom teaching

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

Special requirements

none

Accompanying material	Electronic tutorials and task collections for the lab exercises Documents from standards
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Separate exam	Yes
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Separate exam

Exam Type	EN Projektaufgabe im Team bearbeiten (z.B. im Praktikum)
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Details	<p>Written test to control the preparation of the lab exercises</p> <p>Observation of the lab exercises performed independent and feedback</p> <p>Evaluation of detailed reports of the lab exercises</p>
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Minimum standard	<p>70 % of the written test correctly</p> <p>80 % of the measurement results correct</p> <p>80 % of the evaluation performed correctly</p> <p>80 % of the discussion makes sense</p>
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