Technology
Arts Sciences
TH Köln

Course Manual HST

High Voltage Technology

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General information

Long name	High Voltage Technology
Approving CModule	HST_BaET
Responsible	Prof. Dr. Christof Humpert Professor Fakultät IME
Valid from	winter semester 2022/23
Level	Bachelor
Semester in the year	winter semester
Duration	Semester
Hours in self-study	60
ECTS	5
Professors	Prof. Dr. Christof Humpert Professor Fakultät IME
Requirements	Atomic model and energy-band model Impedances in the AC circuit Complex AC calculation Three-phase system Alternating electric field Dielectric material properties
Language	German
Separate final exam	Yes

Literature

- Küchler; Hochspannungstechnik (Springer)
- Beyer, Boeck, Möller, Zaengle; Hochspannungstechnik (Springer)
- Hasenpusch; Hochspannungstechnik - Einführung und Grundlagen (Franzis)
- Hilgarth; Hochspannungstechnik (Teubner)
- Kind, Feser; Hochspannungsversuchstechnik (Vieweg)

Final exam

Details	Written examination, in some cases also oral examination, with the following content: - Free text answers to inquire about the necessary knowledge (e.g., typical breakdown voltages of insulating arrangements or types of high voltage equipment) - Free-text answers and drawing diagrams to explain mechanisms of discharge development and discharge and arc extinction - Text exercises for the calculation, dimensioning and analysis of insulation arrangements
Minimum standard	50% of the questions and tasks correctly solved
Exam Type	EN Klausur

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	High voltage grids, types, requirements, function Electrical stress due to operational and overvoltages, types of overvoltages High voltage insulating materials - Gaseous insulating materials: discharge development, air and SF6, Paschen law, spark and arc discharge - Solid insulating materials: Discharge development, layered arrangements, partial discharges, aging, discharges along insulating surfaces - Liquid insulating materials: discharge development, oil-paper insulation, liquid nitrogen - Vacuum insulation: Discharge development, influence of contact materials Equipment of high voltage technology - Requirements for equipment, in particular for switchgear and switching devices - Switchgear: air-insulated switchgear, outdoor switchgear, SF6-insulated switchgear - Circuit breakers: principles of arc quenching, SF6 circuit breakers, vacuum circuit breakers - Other equipment: cables, transformers

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 Software tool for simplified calculation of electric field distributions
Separate exam	No

Skills	Analyze discharge processes in gases, liquids and solids - Explain and apply dependence on boundary conditions (pressure, material, electrode distance) - Give reasons for the dependence on degree of inhomogeneity - Determine the influence of the voltage shape - Calculate ignition and breakdown voltages Dimension and design insulating arrangements - Uniform, weakly non-uniform and strongly non-uniform insulation arrangements in gases - Arrangements of solids, transverse and longitudinal lamination - Paper-oil insulation arrangements Select and dimension switchgear and switchgear - Select switching principle depending on the required functions - Select a suitable arc extinguishing principle depending on the voltage shape and height

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	Safety in the high voltage laboratory - Compliance with safety distances - Behavior in the test field - Safety devices and systems Basics of generation and measurement of high voltages Discharge development in different gases in different electrode arrangements
Skills	Plan high voltage tests and perform them safely - Analyze, modify and verify experimental setups - Apply security rules Use the electric field calculation tool and judge the accuracy of the results Measure high voltages - Apply and compare different measurement methods - Calculate voltage ratio of measuring equipment Measure ignition and breakdown voltages - Record and evaluate test results - Explain results with discharge models - Justify and explain deviations from the theory Manage complex tasks in a team Summarize, evaluate and interpret results in written form

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 Software tool for simplified calculation of electric field distributions
Separate exam	Yes

Separate exam

Exam Type	EN Projektaufgabe im Team bearbeiten (z.B. im Praktikum)
Details	Written test to control the preparation of the lab excercises Evaluation of the preparatory documents (calculation results) Evaluation of the discussion with the students and of the lab exercises on the basis of a structured protocol Evaluation of detailed reports of the lab exercises of the team
Minimum standard	70 % of the written test correctly 80% of the prepared calculation results correct 80 % of the measurement results correct 80 % of the evaluation performed correctly 80 % of the discussion makes sense