Valid from 2024.HS

Module description: Physics 3: Fields and Waves

Module Code	t.BA.ETP.PHY3FW.19HS
ECTS Credits	4
Language of Instruction/Examination	German
Organizational Unit	IAMP
Module Coordinator	Ralf Markendorf
Legal Framework	The module description is part of the legal basis in addition to the general academic regulations. It is binding. During the first week of the semester a written and communicated supplement can specify the module description in more detail.
Module Characteristic	Type 3a 2 lecture lessons per semester week and class+ 2 lab bi-weekly lessons per semester and half-class
Module Description	Students acquire the physical and technical basics of electric and magnetic fields, and the coupling between these and wave theory. They learn about and apply Maxwell's equations. Using selected examples from these fields, they learn to adopt the state-of-the-art technical thinking of an engineer.
Module Content	• Fields as the basis of electromagnetism (repetition): field concept, electric and magnetic field, field as energy carrier • Stationary situations: E-field, Gaussian theorem, potential, voltage, B-field, Ampère's law, Lorentz force, electric and permanent magnet, permeability, various capacitors and coils • Coupling of electric and magnetic fields: law of induction, self- and counter-induction in wires (for later: waves on lines see below), skin effect and line damping (also for line waves see below), transformer, generator, flow, electromagnetic (Hertzian) dipole, electromagnetic coupling, Maxwell equations • Waves in general: Mechanism of wave propagation using the example of electromagnetic waves, carrier medium, wave equation, wave function, wavelength, phase, frequency, velocity etc., energy and pulse propagation in waves, transverse and longitudinal waves, sound, elastic waves, water waves, waves on a tensioned string • Electromagnetic and line waves: Electromagnetic wave propagation, propagation and attenuation constant, dispersion, phase and group velocity, polarization, antenna reflectors & directors, typical electromagnetic wave phenomena: Superposition, interference, Doppler shift, reflection and standing waves, guidance in optical fibres (light waves) and on wires (line waves) • Technical applications: lasers; glass fibres etc.
Prerequisite Knowledge	Physics from the technical BMS.

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Learning Objectives (Competences)

Students...	Competencies	Taxonomies
Students have understood the fundamental relationships of physics in the form of the fundamental laws, conservation laws and physical concepts and can apply them to concrete situations.	M, F	K2, K3
Students learn about and can apply the inductively influenced physical way of thinking and working as part of the modern way of thinking and working of the engineer. This includes such important methods as experimenting, modelling or idealising and analogous thinking. They are able to check the correctness of results from experiments and models by rough calculations, borderline case considerations and evaluation of their plausibility by comparison with empirical values from technology or everyday life.	M, F	K2, K3
They are able to gain new knowledge through physical experimentation by means of observation, recognition (retrieval) of physical relationships, acquisition of data and their numerical evaluation and interpretation.	F, M	K2, K3
They can model physical situations, identify performance and validity limits of the model, further develop and refine models and obtain (qualitative and) quantitative results from the models.	F, M	K2, K3

Performance Assessment

End-of-module exam	Assessment	Length (min.)	Weighting	Form
written exam	Grade	90	100	acc. to module agreement

Performance assessment during the semester	Assessment	Length (min.)	Weighting	Form
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Classroom Attendance Requirement

None

Learning material

Comments