

Module title		SM Code
Theoretical Electrical Engineering		TET
Module lecturer	Faculty	
Prof. Dr. Oliver Sterz	Electrical Engineering and Information Technology	
Module language	Number of SWS / WSH	ETCS credits
English	4 SWS / WSH	5
Teaching format		
Seminar-based teaching with approx. 15% practical component: simulation on computer workstations.		

Semester according to the study plan	
1 st semester (Master)	
Attendance/classroom hours	Additional independent study
56 hours	Preparation and follow-up work: 62 hours Exam preparation: 32 hours
Type of examination / Requirements for the award of the credit points	
Written exam: 90 minutes	

Teaching content
<p>Introduction</p> <ul style="list-style-type: none"> • Maxwell's equations in differential and integral form • Classification of electromagnetic problems • Classification of differential equations and boundary conditions • Helmholtz's theorem • Uniqueness theorem

Electrostatics

- Electric potential
- Laplace and Poisson equations
- Work and energy in electrostatics
- Conductive bodies
- Potentials of different charge arrangements. Multipole expansion
- Specific solution methods for Laplace's equation

Magnetostatics

- Magnetic potentials
- Continuity conditions
- Multipole expansion for vector potential
- Inductance

Electric and magnetic fields in matter

- Field of a polarized object
- Field of a magnetized object

Time-varying fields

- Skin effect, eddy currents

Conservation laws

- Conservation of charge
- Conservation of energy and Poynting's theorem
- Maxwell's stress tensor
- Angular momentum

Electromagnetic waves

- Wave equation
- Plane waves and solutions for different materials
- Refraction and reflection in surface waves
- Waveguides

Radiation

- Dipole radiation
- Point charges

Learning objective: Professional competence**After successfully completing this module, students will be able to**

- understand the basic concepts and technical terms of electrodynamics (1)
- understand conservation laws (1)
- describe electromagnetic phenomena mathematically on the basis of fundamental physical quantities, using the fundamental equations of electromagnetism (Maxwell's equations), and solve the fundamental equations (2)
- draw qualitative conclusions using a small number of physical concepts and laws (2)
- understand and apply Maxwell's equations to calculate field distributions (3)

Literature**Recommended reading**

- Griffiths, D. J. (2017). *Introduction to Electrodynamics*. Cambridge University Press
- Henke, H. (2015). *Elektromagnetische Felder*. Springer-Verlag
- Edminister, J., & Nahvi, M. (2018). *Schaum's Outline of Electromagnetics* (Fifth Edition). McGraw Hill
- Sadiku. M. N. O. (2015). *Numerical Techniques in Electromagnetics with MATLAB®* (Third Edition). CRC Press

The numbers in brackets indicate the levels to be achieved: (1)-know | (2)-can | (3)-understand and apply