Valid from 2024.HS

Module description: Strength of Materials 2

Module Code	t.BA.MT.FL2.19HS
ECTS Credits	2
Language of Instruction/Examination	German
Organizational Unit	IMES
Module Coordinator	Ralf Pfrommer
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 1a 2 lecture lessons per semester week and class
Module Description	Students learn to calculate stresses due to bending in simple and composed cross-sections and to determine the bending lines of statically determinate and indeterminate single and multi-field beams as well as to calculate stresses and deformations due to torsion. Finally, an introduction to the topic of transverse shear in case of bending is given.

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Module Content	• 1. Stress due to bending • 1.1 Introduction to the calculation of bending stresses • 1.1.1 Neutral fibre, tension and compression fibre • 1.2 Second order moments of inertia • 1.2.1 Simple cross-sections • 1.2.2 Steiner's theorem • 1.2.2 Composed cross-sections, profile cross-sections • 1.2.3 The area inertia tensor • 1.2.4 Principal axes and principal moments • 1.3 Application examples • 2. Deformations due to bending stress • 2.1 The differential equation of the bending line • 2.2 Solving the ODE of the bending line for statically determinate beams • 2.2.1 Kinematic boundary and transition conditions • 2.2.2 Bending lines of single-span beams under single and line loads • 2.2.3 Bending lines of multi-span beams under single and line load • 2.3 Solution of the DGL of the bending line of statically indeterminate beams • 2.3.1 The line load as the fourth derivative of the bending line • 2.3.2 Dynamic boundary conditions • 2.3.3 Bending lines of one-field beams under single and line loads • 2.4 Superposition and combination of bending lines • 2.4.1 Deformations of frames • 2.4.2 Determination of reactions forces of statically indeterminate beams • 3. Torsional loading • 3.1 Fundamentals • 3.2 Torsion of circular cylindrical shafts • 3.2.1 Polar moment of inertia • 3.2.2 Torsional stresses and their distribution • 3.2.3 Torsion angle and twisting • 3.3 Torsion of thin-walled closed profiles • 3.3.1 Shear flow • 3.3.2 Bredt's first and second formula • 3.3.3 Stresses and torsion angles • 3.3.4 Examples • 3.4 Torsion of thin-walled open profiles • 3.4.1 Stresses and torsion angles • 3.4.2 Examples • 4 Transverse shear • 4.1 The short beam • 4.1.1 Shear stress distribution in the rectangular cross-section • 4.1.2 Bonded and riveted beams • 4.2 Interaction of the basic stresses • 4.2.1 Examples
Prerequisite Knowledge	This module requires mastery of the matters of the classes Analysis 1 and 2, Algebra and Statistics 1 and 2 as well as Statics and strength of materials 1.

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Learning Objectives (Competences)

Students...	Competencies	Taxonomies
Can define the deflection curve of statically determined beams under different support and loading conditions	M, F	K4
Can write down and integrate the differen-tial equation of the deflection curve and can explain the quantities without any aids	M, F	K4
Can define the deflection curve of statically undetermined beams under different support and loading conditions	M, F	K4
Can determine shear stress distributions on short bending beams for simple cross-sections and calculate riveted and bonded beams.	M, F	K4
Can superimpose deflection curves in order to calculate support reaction forces of statically undetermined beams	M, F	K4
Is able to calculate deformation and stress of circular shafts and thin walled profiles under torsional loading	F, M	K4
Can calculate bending stresses of simple and composed cross-sections and determine the main axes of a cross-section.	M, F	K4

Performance Assessment

End-of-module exam	Assessment	Length (min.)	Weighting	Form
written exam	Grade	90	80	acc. to module agreement

Performance assessment during the semester	Assessment	Length (min.)	Weighting	Form
written exam	Grade	45	20	acc. to module agreement

Classroom Attendance Requirement

None

Learning material

- Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2, Elastostatik Springer-Verlag, 13. Auflage, 2017 (www.springer.com)

Comments

The lecturers in FL2 jointly create a end-of-semster exam that is the same for all classes. The lecturers create the midterm exams individually, but coordinate them with each other with respect to the level of difficulty.