Linnæus University

Dnr: 2020/3365-3.1.2.2

Course syllabus

Faculty of Technology

Department of Building Technology

4BY372 Balkteori, 5 högskolepoäng
4BY372 Beam Theory, 5 credits

Main field of study
Civil Engineering

Subject Group
Building Technology

Level of classification
Second Level

Progression
A1F

Date of Ratification
Approved 2019-06-10
Revised 2020-10-15 by Faculty of Technology. Revision of content and the objectives are adjusted.
The course syllabus is valid from autumn semester 2021

Prerequisites
Multivariable Calculus and Vector Calculus, 7.5 credits, Analysis of structures7,5 credits, The finite element method 7,5 credits, Conceptual structural design 10 credits, or the equivalent.

Objectives

Knowledge and understanding
To pass, the student should be able to

- account for different types of beams, their functioning and function-limiting phenomena.
- account for the beam theories according to Bernoulli-Euler and Timoshenko, theories for torsion according to St Venant and Vlasov and for the basics of theory for analysis of instability in a beam.
- explain the concepts, quantities and constants that are used in advanced beam analyses.

Competence and skills
To pass, the student should be able to

- calculate deformations, stresses and instability loads for straight elastic beams with different cross-sections and arbitrarily loaded in 3D with forces, bending moments, torque, bi-moments and self-tension.
- calculate, numerically approximately or exactly, stiffness matrix and load vector for different types of beam and be able to analyze structures that are composed of beams.
- calculate deformations and stresses for a single curved elastic beam loaded in 2D.
- calculate cross-sectional constants for beams with different types of cross sections.
- use tables and hand books with information on the constants and instabilities of beams.

Judgement and approach
To pass, the student should be able to

- assess the function of a beam (deformation patterns, stiffness properties, stress distributions and instability phenomena) based on its design and load.
- assess the type of calculation method that is most suitable for different cases.

Content
The course deals with calculation methods for elastic beams with symmetrical/unsymmetrical, open/closed, solid/thin-walled, constant/varying cross sections, exposed to load in 3D, to torque, bi-moment and self-stress:

- Overview of different types of beams, functional limiting phenomena and beam theories.
- Bernoulli-Euler and Timoshenko's theories of the action of bending moment, transverse force and normal force and self-tension.
- St Venant's and Vlasov's theories for the effect of torque.
- Second order theory for instability phenomena.
- Analytical and/or numerical solution of the differential equations of the different beam theories.
- Matrix formulation of beam stiffness and load for the possibility of computer-based analysis of composite 3D structures.

The course includes one to two assignments. These can relate to experimental testing combined with theoretical calculations or implementation of theory in computer code.

Type of Instruction
The teaching consists of lectures where theory is introduced, seminars or exercises where application of different methods is discussed based on a problem and laboratory exercises where practical skills are used. Laboratory exercises and seminars are compulsory elements in the course.

Examination
The course is assessed with the grades A, B, C, D, E, Fx or F.

The grade A constitutes the highest grade on the scale and the remaining grades follow in descending order where the grade E is the lowest grade on the scale that will result in a pass. The grade F means that the student’s performance is assessed as fail (i.e. received the grade F).

The examination is divided into the following

- Written exam A-F 4
- Assignments A-F 1

The course is examined through individual written examination and assignments. The final grade is mainly determined by the grade on the written exam, but additional credits from approved assignments can contribute to an increased final grade on the course.

Repeat examination is offered in accordance with Local regulations for courses and examination at the first and second-cycle level at Linnaeus University.

If the university has decided that a student is entitled to special pedagogical support due to a disability, the examiner has the right to give a customised exam or to have the student conduct the exam in an alternative way.

Course Evaluation

During the implementation of the course or in close conjunction with the course, a course evaluation is to be carried out. Results and analysis of the course evaluation are to be promptly presented as feedback to the students who have completed the course. Students who participate during the next course instance receive feedback at the start of the course. The course evaluation is to be carried out anonymously.

Other

Grade criteria for the A–F scale are communicated to the student through a special document. The student is to be informed about the grade criteria for the course by the start of the course at the latest.

The course material is presented on a web study site that the students reach via the Internet. Access to the Internet and computers is available in the university's computer rooms and at the university library.

Required Reading and Additional Study Material

Course compendium of approximately 300 pages, lecture notes, exercises and formulary. Tutorial for assignments.

Austrell. P.-E. et al.: CALFEM - A finite toolbox for MATLAB. Studentlitteratur, 2004, ISBN: 9789188558237, approximately 300 pages.