Vibrations and Fatigue in Mechanical Structures

Programme course

6 credits

Mekaniska svängningar och utmattning

TMMI09

Valid from: 2017 Spring semester

Determined by
Board of Studies for Mechanical Engineering and Design

Date determined
2017-01-25

Main field of study
Mechanical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Mechanical Engineering, B Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Basic courses in Mathematics (Analysis), Mechanics, and Solid Mechanics

Intended learning outcomes
Many failures in mechanical structures are caused by material fatigue. Fatigue may appear when a structure is loaded by a cyclic load, and in many cases this load may come from resonance vibrations of the structure. Thus, knowledge of the vibrational behaviour of mechanical systems is a prerequisite in understanding the fatigue phenomenon. The course Vibrations and Fatigue in Mechanical Structures will provide understanding and knowledge about these phenomena. After the course, the student should be familiar with the following items that are dealt with in the course:
- the physical behaviour of vibrating mechanical systems,
- theories used when analysing practical vibrational problems,
- influence of different structural parameters on the vibrational behaviour of structures, material fatigue phenomena, and
- theories used when analysing fatigue problems.

Course content

On vibrations: Fundamental relationships describing the behaviour of vibrating mechanical systems. Equations of motion for vibrating systems. Influence of mass, stiffness, and damping. Resonances and its consequences for the mechanical system. Vibrations of discrete systems and continuous systems.
On fatigue: Fundamental relationships describing the fatigue phenomenon. High-cycle fatigue and low-cycle fatigue. The Wöhler diagram and the Haigh diagram. Safety factors. Damage accumulation, the Palmgren-Miner rule. Load spectra. The Ramberg-Osgood material model. Fatigue life models according to Morrow and Coffin-Manson. Influence of stress concentration.

Teaching and working methods

Lectures, tutorials, laboratory work, and problem solving.

Examination

UPG1	Laboratory work and home assignments	1.5 credits	U, G
TEN1	A Written Examination	4.5 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5

Department

Institutionen för ekonomisk och industriell utveckling

Director of Studies or equivalent

Peter Schmidt

Examiner

Robert Eriksson

Course website and other links

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Additional literature

Books

Dahlberg, T, (2001) *Teknisk hållfasthetslära, med tillhörande formelsamling*
ISBN: 91-44-01920-3

Compendia

Dahlberg, T, Material fatigue, Kompendium

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.