Linnæus University

Jnr: 2019/4028-3.1.2.2

Course syllabus

Faculty of Technology
Department of Mechanical Engineering

4MT322 Experimentell mekanik, 7,5 högskolepoäng
Experimental Mechanics, 7.5 credits

Main field of study
Mechanical Engineering

Subject Group
Mechanical Engineering

Level of classification
Second Level

Progression
A1N

Date of Ratification
Approved by Faculty of Technology 2019-12-16
The course syllabus is valid from autumn semester 2020

Prerequisites
Bachelor of Science in Engineering (180 credits) in which Algebra and analysis corresponding to 22.5 credits and Solid Mechanics or Structural Mechanics, 7.5 credits are included.

Objectives

After the course the students shall:

- be familiar with analogue-to-digital converters and their limitations
- be familiar with different sensors and measurement methods for the measurement of vibration, force, strain, rotation speed or angular velocity of a rotating shaft and angular velocity variation of rotating shaft's
- be familiar with selection and mounting of sensors, selection and mounting of different equipment for excitation of structural vibration and system identification signals
- be familiar with tensile testing
- be able to estimate Power Spectral Density, Power Spectrum, Energy Spectral density, Frequency Response Functions, Coherence functions based on e.g. measured sampled vibration signals as well as to estimate associated bias and random errors
- be able to specify and carry out an experimental modal analyse of a simple beam structure
- be able to carry out an operating deflection shape analyse of a simple beam structure
- understand fundamental rotating machinery analysis and be able to understanding and solve vibration problems of rotating machinery

- be familiar with faults that may occur in machine elements such as cogwheels and bearings as well as how such faults excites the supporting machinery structure
- be familiar with signal processing methods for the extraction of condition monitoring information on faults that may occur in cogwheels and bearings from vibration signals measured on machineries.

Content

The course contains:

- Sensors for measurement of vibration, force, strain, rotation speed or angular velocity of a rotating shaft and associated signal conditioning,
- Tensile testing,
- Analogue-to-digital converters, ”Effective Number Of Bits (ENOB)” and a number of A/D- converter principles,
- Fourier transform – Diskret Fourier transform,
- Stochastic processes and relevant statistical concepts,
- Power Spectral Density, Power Spectrum, Frequency Response Function, Coherence function and associated bias and random errors,
- Modal concepts in analytic and matrix formulations:

  - Damping models
  - Modal parameters and frequency responses
  - Determination of modal parameters
  - Multiple references
  - Operating deflection shape (ODS) analysis

- Varvtalsanalys av roterande maskiner,
- Faults that may occur in machine elements such as cogwheels and bearings as well as how such faults excites the supporting machinery structure,
- Signal processing methods for the extraction of condition monitoring information on faults that may occur in cogwheels and bearings from vibration signals measured on machineries.

Type of Instruction

Theories and examples are presented at lectures. Experimentation is carried out during laboratory sessions. Further, projects in which the computer code MATLAB will be used, assist in the learning process.

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 assesment methods consists of three parts, one written examination, four compulsory laboratory reports and three compulsory homework assignments.
The written Take Home Exam (4 credits) is assessed with the detailed scale above. Laboratory reports (2.5 credits) and take home assignments (1 credits) are assessed with the grades pass or fail.

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 customized 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.

Required Reading and Additional Study Material

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Anders Brandt: Noise and Vibration Analysis - Signal analysis and experimental procedures, 1st ed., John Wiley Sons Inc, 2011. ISBN: 9780470746448. 464 pages.

Additional literature may be used and material from the department.