GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2026-2027

Vibrations and Signals (E048600)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2026-2027

A (semester 2)	English	Gent
B (semester 2)	Dutch	Gent

Lecturers in academic year 2026-2027

Loccufier, Mia	TW08	lecturer-in-charge

Offered in the following programmes in 2026-2027	**crdts**	**offering**
Bridging Programme Master of Science in Engineering: Ships and Marine Technology	6	A
Bridging Programme Master of Science in Mechanical and Electrical Systems Engineering	6	A
Master of Science in Electromechanical Engineering(main subject Maritime Engineering)	6	B
International Master of Science in Advanced Design of Sustainable Ships and Offshore Structures	6	A
Master of Science in Electromechanical Engineering	6	B
Master of Science in Engineering: Ships and Marine Technology	6	B
Master of Science in Engineering: Ships and Marine Technology	6	A
Master of Science in Mechanical and Electrical Systems Engineering	6	A

Teaching languages

English, Dutch

Keywords

Vibration analysis, Lagrangian equations of motion, structural and machine dynamics, modal analysis, vibration signatures, signal types.

Position of the course

This course aims to offer fundamental insight into vibration of rotating and non-rotating machines and structures, referred to as mechanical systems. The motion of a mechanical system is studied as a kinetic and potential energy interaction, influenced by energy dissipation and forced by energy input. This energetic approach is modelled with Lagrangian equations.

Modes of vibrations, modal analysis and the quadratic eigenvalue problem are thoroughly analyzed for linearized dynamics. Different physical configurations of machines and structures yield different modes of vibration, revealed physically as diverse mutual motion of mechanical subsystems.

This insight forms the basis to research topics as experimental modeling, dynamic dominating behavior triggered by various loads, separation of vibration signatures based on dedicated signal processing and vibration control based on energy isolation, absorption and dissipation.Rotor dynamics are introduced. The latter explains the transverse bending of flexible shafts due to rotor and bearing interaction.

The course emphasizes the important fundamental concepts to perform the dynamical analysis of mechanical systems such that an optimal design can be obtained, control devices can be designed and industrial experiments and software packages can be understood.

Contents

- Introduction: Dynamic behaviour of mechanical structures and machines
- Modelling: Lagrange's equations
- Linear models
- Free vibration, energy method, Forced vibration
- Dynamic loads: imbalance, multi-cylinder machines
- Modal analysis: Vibration modes of undamped, proportionally damped and non-proportionally damped systems
- Frequency response analysis
- Energy based vibration control: vibration isolation, vibration absorption, vibration damping.
- Structure preserving model reduction techniques.
- Continuous systems: axial vibration, torsional vibration, transverse vibration
- Introduction of rotor dynamics
- Determination of vibration characteristics based on dedicated signal processing

Initial competences

linear algebra, differential calculus, basic physics, basic mechanics, mechanics of materials, signals and systems. nonlinear systems

Final competences

1 To model of rotating and non-rotating mechanical systems based on Lagrangian equations
2 Calculate vibration levels of mechanical structures subjected to dynamic loads.
3 Perform a modal analysis and formulate structural modifications for continuous and discrete systems.
4 Design of vibration control devices.
5 Identify modal parameters from an experiment
6 Apply model structure preserving reduction techniques.
7 Determine vibration characteristics through signal processing of measurements

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Practical, Independent work

Study material

Type: Syllabus

Name: Mechanical Vibrations
Indicative price: € 12
Optional: no
Language : English
Number of Pages : 240
Available on Ufora : Yes
Online Available : Yes
Available through Student Association : Yes

References

- Mechanical Vibrations, S. Rao, Prentice-Hall, 2005.
- Rotating Machinery Vibration: From Analysis to Troobleshooting, M.L. Adams, Marcel Dekker Inc., 2000.
- Harris' Shock and Vibration Handbook, C. M. Harris and A. G. Piersol, McGraw-Hill, 2002.
- Modal testing, theory and practice, D.J. Ewins, John Wiley and Sons, New York, 2000.
- Mechanical Vibrations, J.P. Den Hartog, Dover publications, Inc. New York, 1984.

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

- Permanent evaluation: the permanent evaluation concerns the execution of measurements and the answering of corresponding questions. The results are handed in as a report.
- During examination period: The oral exam part is a questioning based on a written preparation. The written exam part is an open-book exam on problems.

Calculation of the examination mark

- permanent evaluation: 4 of 20
- oral exam part: 8 of 20
- written exam part: 8 of 20
- The result of the permanent evaluation can be transferred to the second examination period.