

Diagnostics

Code: MK3DIAGG06G117-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 4th year, 1st semester

Its prerequisite(s): Maintenance Engineering II.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Maintenance strategies. Role of technical diagnostics in maintenance, condition-based maintenance. The main fields of technical diagnostics: vibration diagnostics, acoustics, ultrasound analysis, thermography, endoscopy, oil analysis. Theoretical background of vibration: sources and types of vibration, statistical evaluation of vibration signals. Fourier spectrum of periodic and non-periodic signals, Fourier transform. Discrete Fourier transform, FFT Short time Fourier transform. Wavelet transform. Sampling, information content in discrete signal (aliasing, leakage). Shannon sampling principle. Windowing, averaging, filtering. Characterisation of machinery vibration. Vibration measurement: methods, equipments. Vibration standards. Machine failures and related symptoms in the time signal and in the spectrum: unbalance, shaft alignment, looseness, and gear faults, electric motor failures. Types of bearings, bearing frequencies. Theoretical background of shock pulse measurement. Application of acoustics, ultrasound analysis, and thermography. Online monitoring systems.

Literature:

Compulsory:

- Czichos, H. (ed.), Handbook of Technical Diagnostics (Fundamentals and Application to Structures and Systems), Springer, 2013.
- Harris, C. M., Piersol, A. G. (ed.), Harris' Shock and Vibration Handbook, McGraw-Hill, 2002
- Taylor, J.: The Vibration Analysis Handbook VCI, 2000
- Taylor, J.: The Gear Analysis Handbook, VCI, 2000
- Taylor, J., Kirkland, D.W.: The Bearing Analysis Handbook, VCI, 2000

Schedule

1st week Registration week

2nd week:

Lecture: Maintenance strategies. Role of technical diagnostics in maintenance, condition-based maintenance.

Practice: Tools of vibration measurement. VibChecker, BearingChecker.

4th week:

Lecture: Theoretical background of vibration: sources and types of vibration, statistical evaluation of vibration signals.

Practice: Introduction to the Condmaster Nova – Leonova Infinity condition monitoring system.

6th week:

Lecture: Discrete Fourier transform, FFT

3rd week:

Lecture: The main fields of technical diagnostics: vibration diagnostics, acoustics, ultrasound analysis, thermography, endoscopy, oil analysis.

Practice: Introduction to the Condmaster Nova – Leonova Infinity condition monitoring system.

5th week:

Lecture: Fourier spectrum of periodic and non-periodic signals, Fourier transform.

Practice: Vibration measurement.

7th week:

Practice: Balancing.

Lecture: Short time Fourier transform. Wavelet transform.

Practice: Shaft alignment.

8th week: 1st drawing week

9th week:

Lecture: Sampling, information content in discrete signal (aliasing, leakage). Shannon sampling principle. Windowing, averaging, filtering.

Practice: Bearing condition evaluation with shock pulse method.

11th week:

Lecture: Machine failures and related symptoms in the time signal and in the spectrum: unbalance, shaft alignment, looseness, and gear faults, electric motor failures.

Practice: Evaluation of machinery condition, case studies.

13th week:

Lecture: Theoretical background of shock pulse measurement.

Practice: Measurements with IR camera.

10th week:

Lecture: Characterisation of machinery vibration. Vibration measurement: methods, equipments. Vibration standards.

Practice: Evaluation of machinery condition, case studies.

12th week:

Lecture: Types of bearings, bearing frequencies.

Practice: Evaluation of machinery condition, case studies.

14th week:

Lecture: Application of acoustics, ultrasound analysis, and thermography. Online monitoring systems.

Practice: Measurements with IR camera.

15th week: 2nd drawing week

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test is on the 8th week and the end-term test is on the 15th week. Students must sit for the tests.

B, for a grade:

The course ends in a mid-semester grade based on the average grade of the two tests.

The minimum requirement of the mid-term and the end-term test is 60% separately. The grade for each test is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, the student once can take a retake test of the whole semester material.