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| **Diagnostics** |

**Code: MFDIA31G03-EN**

**ECTS Credit Points: 3**

**Evaluation: exam**

Year, Semester: 3rd year/1st semester

Number of teaching hours/week:

Lecture: **2**

Practice: **1**

**Prerequisites: Machine Elements II. MFGEP32G05-EN**

**Topics**:

Basic maintenance philosophies and strategies: Diagnostics and condition based maintenance.

Vibration analyses: oscillation, mass, spring, damper, sine waves, amplitude, frequency, phase, time and frequency domains, spectrum, displacement, velocity, acceleration, natural frequencies, resonance, Fourier transform, DFT, FFT, FFT analyzers, frequency resolution, acquisition time and averaging.

Condition monitoring of machines: Dynamic behavior of rotating machinery, vibration based methods of data acquisition and analysis techniques, vibration signal measurement and recording instrumentation, vibration level standards, rolling element and journal bearing faults, gear wear detection, typical vibration problems: unbalance, misalignment, structural weakness, loose parts, sensors, transducers, shock pulse methods.

Balancing: balancing methods, trial weights, correction weights.

Shaft Alignment. Acoustics for Machinery: Noise behavior of a machinery, measurement of sound radiation of machines, determination of sound power, sound level meters and analyzers. Infra-red thermography: Infrared radiation and its applications, thermal imaging for industrial inspections

**Literature:**

1. Maldague, X. P.: Theory and Practice of Infrared Technology for Nondestructive Testing, Wiley, 2001.
2. Nagy, I.: Technical Diagnostics I. - Vibration Analysis, Delta3N Kft., 2010
3. Taylor, J.: The Vibration Analysis Handbook VCI, 2000
4. Taylor, J.: The Gear Analysis Handbook, VCI, 2000
5. Taylor, J., Kirkland, D.W.: The Bearing Analysis Handbook, VCI, 2000

**Schedule**

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| **1st week:**  **Lecture:** Basic maintenance philosophies and strategies.  **Practice:** Introduction to measuring equipment of the laboratory I. | **2nd week:**  **Lecture:** Diagnostics and condition based maintenance, predictive maintenance.  **Practice:** Introduction to measuring equipment of the laboratory II. |
| **3rd week:**  **Lecture:** Vibration analysis: oscillation, mass, spring, damper, sine waves, amplitude, frequency, phase.  **Practice:** Vibration measurement I. | **4th week:**  **Lecture:** Time and frequency domains, spectrum, displacement, velocity, acceleration, natural frequencies, resonance.  **Practice:** Vibration measurement II. |
| **5th week:**  **Lecture:** Fourier transform, DFT, FFT, FFT analyzers, frequency resolution, acquisition time, averaging.  **Practice:** Vibration measurement III. | **6th week:**  **Lecture:** Condition monitoring of machines: Dynamic behavior of rotating machinery, vibration based methods of data acquisition and analysis techniques.  **Practice:** Vibration analysis IV. |
| **7th week:**  **Lecture:** Vibration signal measurement and recording instrumentation, vibration level standards, rolling element and journal bearing faults, gear wear detection.  **Practice:** Vibration analysis V. | **8th week:**  Mid-term test. |
| **9th week:**  **Lecture:** Typical vibration problems: unbalance, misalignment, structural weakness, loose parts.  **Practice:** Vibration analysis VI. | **10th week:**  **Lecture:** Sensors, transducers,the shock pulse method.  **Practice:** Application of the shock pulse method. |
| **11st week:**  **Lecture:** Balancing methods, trial weights, correction weights  **Practice:** Balancing. | **12nd week:**  **Lecture:** Shaft alignment methods  **Practice:** Shaft alignment |
| **13rd week:**  **Lecture:** Acoustics for machinery: Noise behaviour of a machinery, measurement of sound radiation of machines, determination of sound power, sound level meters and analyzers  **Practice:** Acoustic measurement | **14th week:**  **Lecture:** Infra-red thermography: Infrared radiation and its applications, thermal imaging for industrial inspections  **Practice:** Measurement with infra-red camera |
| **15th week:**  **End-term test** |  |

**Requirements**

**A, for a signature:**

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. The attendance on practice class will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

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

**B, for a grade:**

The course ends in an **exam grade (ESE)**. The grade for the 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)