Machine Repairing I.

Code: MFGPJ31G03-EN
ECTS Credit Points: 3
Evaluation: exam
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Technology of Structural Materials MFSAT31G02-EN
Topics:
Basics concepts of machine failures and repairing. Requirements of reconditioned parts. The progress of failure inspections and analysis reports. Determinative factors of fraying. Types and measurement modes of fraying. Protecting machinery parts against loss of surface. Physical and chemical attritions. Optimizing the efficiency and reliability of machinery. Principles and techniques to reduce "self induced failures". Characteristics and nature of faults. Providing techniques and procedures that extend machinery life and achieve optimum machinery reliability. The most pertinent aspects of identifying and repairing faulty equipment. In laboratory practice students study defective disassembled machine parts, examine and reconditioning of worn components.
Literature:
Required:

1. Heinz P. Bloch, Fred K. Geitner: Machinery Component Maintenance And Repair, Elsevier, 2004.

Recommended:

1. Fred K. Geitner, Heinz P. Bloch: Maximizing Machinery Uptime, Gulf Professional Publishing, 2006.
2. Ricky Smith, R. Keith Mobley: Industrial Machinery Repair: Best Maintenance Practices Pocket Guide, Elsevier, 2003

Schedule

1st week: **Lecture:** Introduction to maintenance engineering, machine repairing and maintenance management: corrective, preventive, predictive methods bath curve, machine lifetime and faults **Practice:** CMMS, RBI in practice	**2nd week:** **Lecture:** Tribology, wear, wear types, wear mechanism. Causes of machine faults. **Practice:** tribotester test measurement
3rd week: **Lecture:** Friction theories, sliding and rolling friction, dry, fluid, COF, hydrodynamic, lubricants **Practice:** Lubricant test, SAE viscosity stages, COF calculation.	**4th week:** **Lecture:** Lubricant stability, purposes, oil, grease, additives, locomotive and gearbox oils, surface roughness **Practice:** An oil test, surface in SEM. wear particles analyses
5th week: **Lecture:** Fatigue and initial cracks in machine operation, WEC, S-N curve, cyclic stress, probalistic nature, residual stresses. Corrossion theories. SCC problems. **Practice:** Crack detection with ultrasonic its technique. A penetration test. Acid etching reagent to measure pitting corrosion.	**6th week:** **Lecture: ISO** Protection from corrosion. Shrink wraps. Reactive coatings. Anodization. Hot deep galvanizing. Chatodic protection of steel structures. **Practice:** A ferrit-oxid analysis with Olympus optical microscope. Software for image processing. Edge detection, filtering. Morphology.
7th week: **Lecture:** Probabilistic risk assessment. A fault tree. An event tree. Failure mode and effect analyses in manufacturing and repairing. Ishikawa diagram before machine repairing. **Practice:** A fault tree in practice. FMEA	**8th week:** **Lecture:** Overview of methods. Machine fault diagnosis I. **Practice:** Main tools for machine repairing. **Mid-term test**

evaluation in practice in one significant mechanical engineering and machine repair problems.	
9th week: **Lecture:** Machine fault diagnosis II. Vibration measurement methods. ISO 10816 standard. Bearings. Gear boxes. Misaligment. Fourier and wavelet transform. Neural networks. Artificial intelligence applications. **Practice:** Devices to vibration diagnosis. Sensors. Vibration measuremet with NI DAQ and FPGA.	**10th week:** **Lecture:** Thermography. An infrared theory. Endoscopy. Eddy-current testing. Acoustic emission. An X-ray tomography. A DPI test. SEM and AFM measurement in machine repairing. **Practice:** measurement with thermocam, image processing software application.
11th week: **Lecture:** Measuring instruments. Length. Angle. Velocity. Rpm. Force, strain gauge. Pressure. Current and voltage measurement. **Practice:** Spider 8 force measurent with software application. Stroboscope to rpm of bearing test-rig.	**12th week:** **Lecture:** Cleaning methods. Manual washing. Ultrasonic part washers. Solvents. **Practice:** Contamination and grease removal in a special chemical bath.
13th week: **Lecture:** Detergents. Contaminations. Immersion. Rinsing. Drying procedures. Wheel blasting. **Practice:** Contamination and grease removal in a special chemical bath.	**14th week:** **Lecture:** Basic machine repairing methods. Repairing of bearings. Bearing faults. **Practice:** Bearing repair techniques. An induction heater.
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 any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as 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 is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:

The course ends in a **mid-semester grade (AW5)**.

It is based on the average grade of the two tests.

The minimum requirement for the mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score	Grade
0-50	fail (1)
50-60	pass (2)
60-75	satisfactory (3)
75-90	good (4)
90-100	excellent (5)

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.