COURSE DESCRIPTION CARD - SYLLABUS

Course name
Machine maintenance

Course

Field of study
Management and Production Engineering
Year/Semester
2/3
Area of study (specialization)
Production Systems
Profile of study
general academic
Level of study
Second-cycle studies
Course offered in
Polish
Form of study
full-time
Requirements
elective

Number of hours

Lecture
15
Laboratory classes
15
Other (e.g. online)
Tutorials
Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Fundamentals of theory of machines and mechanisms, engineering metrology and measurements, knowledge of the principles of technical drawing and the ability to read technical documentation. Ability for self-learning and knowledge acquiring, basing on library (including e-resources) and Internet resources (e.g. Moodle and others).

Course objective

Students receive theoretical knowledge and practical skills involving the organization of machine maintenance in an industrial plant, as well as methods for recognition and assessment of the technical condition of machines and their components, damage detection and machine maintenance.

Course-related learning outcomes

Knowledge

Student after completing the course has knowledge of objectives and scope of activities related to the

machine maintenance. He knows the typical causes and effects of damage and malfunctions in machines and their components and how to eliminate these causes and effects. He knows the methods and techniques for machines condition monitoring. Student has knowledge about the methods of diagnostic tests (including non-destructive testing) and technical activities related to the machine maintenance.

Skills

Student after completing the course is able to propose appropriate methods and systems of monitoring the technical condition for particular machine classes (critical, non-critical machinery) based on the reliability and economic analyses. He knows how to assess the general technical condition and operating state of machines (in particular rotating machines) based on the methodology described in the standards. He knows how to apply selected techniques and methods of technical diagnostics. Student knows how to use the apparatus and devices used for the detection of defects and damages of machines and its components as well as the instrumentation and equipment used in machine maintenance. He knows how to perform typical tasks related to maintenanceof machines and their subassemblies such as: rotors (balancing), shafts (alignment), bearing nodes, gear boxes, belt transmisions. He can detect leaks in pneumatic systems, detect and eliminate undesirable phenomena in hydraulic systems.

Social competences

Student understands the importance of machine maintenance in economic terms, especially in the continuous process plants (strategic plants). Student is aware of the importance of engineering activities and responsibility for the quality of performing tasks, especially in the aspect of human and environmental safety. He knows how to think and act creatively and proactively. He is able to organize teamwork and to actively cooperate while performance of tasks.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory classes:

Short entry tests before each laboratory exercise. Assessment of knowledge and skills, as well as activity during carried out experiments. Evaluation of mastery of course content, skills and acquired competencies based on the quality of individually prepared reports. The substantive and computational correctness, report completeness and the ability to specifying conclusions, remarks and observations are verified. Necessary condition to pass the laboratory: passing a set of laboratory exercises and getting the required number of points from entry tests and reports.

Lecture

Written or distance tests (wia MOODLE platform): 10-20 issues covering the entire lecture material and issues indicated for own studies (self-studying).
Grading scale both laboratory and lecture (exam): below 60% unsatisfactory; 60-67% satisfactory, 68-75% satisfactory plus; 76-83% good; 84- 91% good plus; 92 -100% very good.

Programme content

Lectures:
The role and tasks of the Maintenance Team in an industrial plant. Types and features of diagnostic and monitoring systems and their selection depending on the machine class. Methodology of general assessment of technical condition and operation of machines (based on PN-ISO standards), in particular the use of vibration measurements to assess the technical condition of rotating machines. Methods and techniques for diagnostic testing (including non-destructive testing methods - NDT). Methods used to detect defects, damage, incorrect operation of machines and their components such as: rotors, shafts, bearings, gears, belt transmissions, pneumatic and hydraulic systems, electric motors. Basic maintenance operations for machines and their components (e.g. balancing of rotors, shaft alignment, bearing lubrication).

Laboratory classes:

The first classes take place in a fan station and rotating machines are tested (expertise and technical condition assessment based on vibration measurements and standards). Next laboratory exercises are carried out on small-size models of machine aggregates and on dedicated stands. These stands enable: balancing of rotors, shaft alignment, leak detection in pneumatic systems (analysis of the advantages and limitations of the use of various techniques), testing and identification of phenomena in hydraulic systems (including cavitation), thickness measurements of tanks and pipes (ultrasonic pulse-echo method), testing of rolling bearings using ultrasonic and thermal methods (determination of wear progress, pollution and lubrication condition). The use of thermography (thermal imaging) and thermometry to detect damage to machinery, equipment and electrical installations.
Main tasks to be performed as a part of the laboratory exercises: detection of damage, malfunction or incorrect functioning of the machine or its component; carrying out or specifying maintenance or service activities, optionally determination other recommendations concerning next machine use.
The Current list of exercises is available on the Moodle platform.

Teaching methods

Lecture: multimedia presentation. The content of lectures is available in electronic form before the beginning of the class, which allows comfortable and active participation in lectures.

Laboratories: the experiments are carried out on specialized didactic stands equipped with dedicated measuring and analyzing systems.
Lectures and laboratories are fully supported on the Moodle e-learning platform. There are available: lectures, multimedia, off-line webinars, source literature (magazines, selected publications, technical notes), instructions for laboratory exercises, report templates, sample reports. It is also possible to perform exercises remotely based on prepared photo and video tutorials and individual data sets. Tests, sets of exam questions, criteria on the basis of which reports are assessed are also available there.

Bibliography

Basic

1. Lindley R., Higgins P.E, Maintenance engineering Handbook, Mc Graw Hill Book Company.
2. Bloch H., Geitner F., Practical Machinery Management for Process Plants, Gulf Publishing Company.

3. Roylance B.J., Wear debris analysis, Coxmoor Publishing Company 1999.
4. Holroyd T.J., Acoustic Emission & Ultrasonic monitoring handbook, Coxmoor Publishing Company 2000.

Additional

1. Selected standards (PN-ISO), measuring & testing procedures, technical magazines: Główny Mechanik, Utrzymanie Ruchu, Maintenance and Reliability.
2. K.N Rao, Handbook of condition monitoring, Elsevier 1996.
3. Legutko S., Eksploatacja maszyn, Wydawnictwo Politechniki Poznańskiej, 2007.
4. Dwojak J, Rzepiela M., Zastosowanie lasera do ustawiania maszyn, Gamma, W-wa 2001.
5. Dwojak J., Rzepiela M., Diagnostyka i obsługa techniczna łożysk tocznych, Gamma, W-wa 2003.
6. Supplementary materials available on the MOODLE e-learning platform.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, self-education based on e-learning resources, preparation for laboratory classes, reports, preparation for tests/exam) [1]	20	1,0

[1] delete or add other activities as appropriate