

Code	V.2.
Course Title (English)	Engineering Design IV –Machine Maintenance and Diagnostics
Course Title (Polish)	Konstrukcja i eksploatacja maszyn oraz grafika inż. IV – Podstawy eksploatacji i diagnostyki maszyn
Credits	7 ECTS

*Language of instruction*    **English**

*Programme*                      Computer Modelling and Simulation, Intelligent Energy, Biotechnology for Environmental Protection

*Type of studies*                BSc studies

*Unit running the programme*                Institute of Thermal Machinery, Institute of Mechanics and Machine Design Fundamentals

*Course coordinator and academic teachers*                **Witold Elsner, Prof.**, Witold Elsner Prof., (Lec.), Paweł Waryś, PhD. (Tut.), Darek Asendrych, Artur Drózdź (Lab.)

*Form of classes and number of hours*

Semester	Lec.	Tut.	Lab.	Proj.	Sem.	Credit points
5	30e	15	45	-	-	7

*Learning outcomes*                The outcome of the course is the ability of the student to understand the principles of machine maintenance and diagnostics. Students will gain the knowledge on the role or maintenance organisation and about the financial implication as well as cost justification. The further outcome is the knowledge on the diagnostic schemes and methods as well as machine common malfunctions and methods for their identification. The further outcome is the knowledge on the engineering design and application of SolidWorks for simulation and design validation.

*Prerequisites*                      Basic knowledge of mathematics and statistics, basics of engineering physics including mechanics, strength of materials and mechanical vibrations

*Course description*                LECTURE  
Maintenance – basic definition. History of maintenance. Total predictive maintenance. Maintenance schemes. Financial implication and cost justification. Benefits of predictive maintenance. Condition monitoring. Off- and on- line systems. Vibration transducers characteristics. Diagnostic basic definition and diagnostic methods of machinery. Diagnostic parameters. Non-destructive tests (NDT) methods. Fundamentals of vibrations. Design and operation of vibration transducers. Data analysis and visualisation methods. Time base plots. Basis of FFT analysis. The orbit plot. Polar and Bode plots.

Machine dynamics. Dynamic stiffness and rotor behaviour. Modes of vibration. Definition of machine malfunctions. Unbalance. Rotor bow. Radial loads and misalignment. Rub and looseness. Fluid-induced instability. Others malfunctions. Machinery condition evaluation vibration standards. Basis of trend monitoring and forecasting.

TUTORIALS: see lecture content

**LABORATORY**

Correlation analysis of vibration signals. Spectral analysis of vibration signals. Spectral leakage and window functions. Vibration measurement of rotating machinery. The rules of vibration transducers installation. Relative and absolute phase. Balancing of rotor systems. Identification and measurements of rotor critical speed. Fluid-induced instability of hydrodynamic bearings. Analysis of the natural frequency of blades. Diagnosis of gear drive. SolidWorks Simulation Overview. Concepts of Stress Analysis. Assembly of Multiply Elements Connections. Mesh Control in SolidWorks Simulation. Validate the design revision. Solid stress analysis. Finite element vibration studies. Motion simulation of mechanisms.

**PROJECT**

Not applicable

**SEMINAR**

Not applicable

*Form of assessment*

Exam

- Basic reference materials*
1. Dihillon B.S., Maintainability, maintenance and reliability for engineers, Taylor & Francis Group, 2006
  2. R. Keith Mobley, An introduction to Predictive maintenance, 2002, Elsevier Science (USA)
  3. Bently D.E., Hatch Ch.T., Fundamentals of Rotating Machinery Diagnostics (Design and Manufacturing) Am.Soc.of Mech. 2003
  4. Mitchell J.S.: An introduction to machinery analysis and monitoring Penn Well Books, 1993
  5. R.C.Sr.Eisenmann: Machinery Malfunction Diagnosis and Correction Vibration, Analysis and Troubleshooting for the Process Industries, Prentice Hall, 1997

*Other reference materials*

For Polish-speaking students:

1. Orłowski Z.: Diagnostyka w życiu turbin parowych. WNT, Warszawa, 2001
2. Cholewa W.; Diagnostyka techniczna maszyn. Wyd. Pol. Śl., Gliwice, 1992
3. Wiśniewski W.: Diagnostyka techniczna wytwórczych urządzeń energetycznych w elektrowniach, PWN, Warszawa 1991

e-mail of the course coordinator and academic teachers	<a href="mailto:welsner@imc.pcz.czest.pl">welsner@imc.pcz.czest.pl</a>
Average student workload (teaching hours + individ. )	6 hours of teaching hours + 4 hours of individual work per week
Remarks:	
<i>Updated on:02.02.2015</i>	