

FACULTY OF **ENGINEERING**

DEGREE COURSE: **INDUSTRIAL ENGINEERING**

MASTER DEGREE: **INDUSTRIAL ENGINEERING / ENERGY**

**SUBJECT:** MEASUREMENT SYSTEMS FOR QUALITY CONTROL

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## **OBJECTIVES**

Provide the students with the basic principles describing the theory of data acquisition and processing for machine condition monitoring and predictive maintenance.

Develop an understanding of the main experimental procedures employed in industrial diagnostics and quality control with a special attention to non-destructive testing.

Provide the students with a basic knowledge on vibration-based structural health monitoring and vibration-based condition monitoring.

Describe the most frequent faults in rotating machinery, their manifestation in terms of vibration and signal processing methods for their detection and recognition.

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## **CONTENTS**

Condition monitoring and quality control basic principles.

Digital signal processing: Periodic, transient and random signals. Time and frequency domain processing. Statistical properties, auto and cross correlation and power spectral density functions. Fourier transform. Cepstrum. Joint time-frequency analysis e wavelets. Filter basic theory. Modulated signals and envelope analysis. Order tracking for rotating machinery. Image signal processing.

Vibration-based structural health monitoring of structures and machines. Main faults in rotating machinery: unbalanced shafts, electrical motors, centrifugal turbo-machines, alternative machines, gears, belt transmissions, rolling bearings.

Experimental methods for quality control: Non-Destructive Testing based on X-ray Tests, Penetrant Tests, Magnetic Tests and Ultrasonic Tests, Vibration sensors, IR thermography, Electronic Speckle Pattern Interferometry and Shearography.

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## **LEARNING OUTCOMES**

Students will learn the basic principles for describing the theory of data acquisition and processing for machine condition monitoring and predictive maintenance.

Students will be able to comprehend the main experimental procedures employed in industrial diagnostics and quality control and to design non-destructive testing procedure based on the techniques presented during the course.

Students will understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring.

Students will be able to recognize the main faults in rotating machinery and to design data processing procedures for the identification of the faults on the basis of the vibration induced on the machinery.

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## **ASSESSMENT**

Written exam: multiple-choice tests and open-ended questions

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## **RECOMMENDED TEXTBOOKS**

The material provided by the multimedia teaching platform is sufficient for a complete comprehension of the concepts presented in the course.

The student can further improve his/her knowledge by reading the following books:

1. E. Doebelin, "Measurement systems: application and design", McGraw-Hill International Edition.
  2. Primers e Technical review available in the web: [www.bksv.com](http://www.bksv.com)
  4. J.L. Semmlow, "Biosignal and Biomedical Image Processing - MATLAB-Based Applications, ed. CRC Press, 2004.
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