240IME32 - Machine Testing

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2012). (Teaching unit Optional)
ECTS credits: 4,5
Teaching languages: Catalan

Teaching staff
Coordinator: Puig Ortiz, Joan
Others: Martinez Miralles, Jordi Ramon

Degree competences to which the subject contributes

Specific:
- CEMEI03. Ability for the design and assays in machines.
- CEEMEC5. Analyse the dynamic phenomenon and its formulation for its application in the development of all and each one of the planning, design and calculation of mechanical elements stages.

Learning objectives of the subject

General:
- Provide basic training in the field of measurement and analysis of mechanical magnitudes, especially dynamic, as well as introduce students in the field of machine and components testing that are usually performed at different stages of development of new products and the industrial environment in general.

Specific:
- To be aware of the importance of machine testing in all the areas of mechanical engineering: development of new products and machinery, research, manufacturing processes control, maintenance, etc.
- To know the concept of standardization and their influence in industrial testing.
- To know the basic techniques for the measurement and analysis of mechanical variables.
- To be able to carry out real measurements in laboratories. To know the basic instrumentation and the proper analysis techniques for every situation.
- To be able to design testing procedures and protocols, i.e. documents that summarize all the stages and requirements of testing: rig and instrumentation requirements, evaluation criteria and standards related to tests.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 27h 24.00%</th>
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<tbody>
<tr>
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<td>Hours small group: 13h 30m 12.00%</td>
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<td>Guided activities: 0h 0.00%</td>
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<td>Self study: 72h 64.00%</td>
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## Content

### 1. INTRODUCTION. TESTING AND MEASUREMENT

**Learning time:** 8h 30m  
Theory classes: 1h 30m  
Practical classes: 1h 30m  
Self study: 5h 30m

**Description:**  
- Why testing?  
- Testing through all the steps of R+D: prototyping.  
- Testing during manufacturing and trading: quality control and verification.  
- Testing during service: control and maintenance.  
- Test procedures: requirements, methodology, data handling, acceptance levels and standards. Regulations.  
- Prototyping: prototyping function at different stages of mechanical design.  
- Rapid prototyping and virtual prototyping (simulations).

### 2. EXPERIMENTAL DATA

**Learning time:** 16h 30m  
Theory classes: 3h  
Practical classes: 3h  
Self study: 10h 30m

**Description:**  
- Static and dynamic mechanical magnitudes. Units.  
- Linear and logarithmic scales.  
- Relative units and reference levels.  
- Measurements reliability: precision, accuracy and resolution.  
- Repeated and random errors. Statistical evaluation of random errors.  
- Calibration: standards.  
- Uncertainty analysis.  
- Parameters fit.  
- Error propagation.

### 3. MEASUREMENT SYSTEM

**Learning time:** 37h 30m  
Theory classes: 6h  
Practical classes: 3h  
Laboratory classes: 4h 30m  
Self study: 24h

**Description:**  
- Elements of a measurement system. Types of transducers.  
- Properties: sensitivity, repeatability, linearity, dynamic range, frequency range, time and frequency response function.  
- Static and dynamic calibration.  
- Transverse sensitivity.  
- A-D conversion.  
- Estimation of the accuracy of a measurement system: uncertainty analysis.
## 4. DYNAMIC MEASURES ANALYSIS

### Learning time:
- Theory classes: 7h 30m
- Practical classes: 3h
- Laboratory classes: 4h 30m
- Self study: 26h 30m

### Description:
- Amplitude domain analysis: density and probability distribution.
- Cycle counting techniques, "Rainflow". Fatigue testing.
- Time domain analysis: power and energy of a signal; correlation.
- Frequency domain analysis: Fourier Series and Fourier Transform, power and energy spectral densities, filters and time windowing.
- Signal analysis applications: Predictive maintenance techniques.

## 5. TEST RIGS

### Learning time:
- Theory classes: 3h
- Self study: 5h 30m

### Description:
- Test rigs: types and characteristics.
- Brake dynamometers.
Bibliography

Basic:


Complementary:


