220617 - Diagnosis and Power Storage

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching unit:</td>
<td>710 - EEL - Department of Electronic Engineering</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2019</td>
</tr>
<tr>
<td>Degree:</td>
<td>MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012).</td>
</tr>
<tr>
<td>(Teaching unit Optional)</td>
<td></td>
</tr>
<tr>
<td>ECTS credits:</td>
<td>5</td>
</tr>
<tr>
<td>Teaching languages:</td>
<td>Catalan, Spanish, English</td>
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**Degree competences to which the subject contributes**

**Specific:**
1. Research, design and development of energy storage and charging systems to efficiently being integrated in industrial/civil processes.
2. Improve technical communication of results.
3. Improve self-learning capacity
4. Research, design and development of new error diagnosis algorithms for improved drive performance.

**Transversal:**
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
5. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

**Teaching methodology**

**Activities in the classroom**
- Presentation of subject contents (theory and problems) with active student participation
- Discussion of practical applications
- Individual or group tutorized work and exercises

**Lab activities**
- Practical exercises to apply the theoretical topics exposed

**Supervised work**
- Preparation of work both for theoretical and practical exercises proposed.

**Learning objectives of the subject**

In the diagnostic block:
- Knowledge of maintenance strategies in an industrial plant
- Ability to analyze different types of industrial drive failures
- Ability to determine and compute condition indicators
220617 - Diagnosis and Power Storage

- Knowledge of artificial intelligence tools applied to diagnosis
- Ability to improve support systems for decision making.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>31h</th>
<th>24.80%</th>
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<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>14h</td>
<td>11.20%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
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</table>
## Content

### (ENG) Module 1: Introduction

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Self study : 3h</td>
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</table>

**Description:**

**Specific objectives:**
To give an overview of main features and characteristics of energy storage systems and their applications as well.

### (ENG) Module 2: Electrochemical Systems. Batteries

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Self study : 3h</td>
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</tbody>
</table>

**Description:**
Main features of batteries
Batteries technologies: Pb/acid, Ni-Cd, Ni-MH, Li-ion
BMS (Battery Management System)
Applications and examples of commercial available systems

**Specific objectives:**
To know the main features of different kinds of batteries and all auxiliary systems required for their practical application.

### (ENG) Module 3: Fuel Cells

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Self study : 3h</td>
</tr>
</tbody>
</table>

**Description:**
Main features. Fuel Cell basics and Technologies: PEMFC, SOFC, AFC
Operation systems. Applications and examples of commercial available systems

**Specific objectives:**
To know the main features of fuel cells and all auxiliary systems required for their practical application.
### Module 4: Supercapacitors

**Description:**
Main characteristics. Electrical Model. Auxiliary systems. Applications

**Specific objectives:**
To know the main features of supercapacitors and all auxiliary systems required for their practical application.

### Module 5: Mechanical Systems

**Description:**
Main features
Flywheels.
Fluid-based systems: pressurized gas and pumping systems.
Applications and examples.

**Specific objectives:**
To know the main features of different kind mechanical systems and all auxiliary systems required for their practical application.

### Module 6: Project Development

**Description:**
Development of a project involving an Energy Storage System. Application fields: renewable energies (photovoltaic, wind), electric mobility (hybrid vehicles or pure electric), onboard systems, etc.

**Specific objectives:**
Application of the delivered knowledge in a project. Discussion of different solutions and design options.
## Module 7: Industrial Maintenance Strategies
**Learning time:** 3h 30m  
Theory classes: 1h  
Self study: 2h 30m

### Description:
- Corrective, preventive and predictive Maintenance
- Types of failures: Mechanical and Electrical

## Module 8: Process variables. Failure Indicators
**Learning time:** 15h  
Theory classes: 4h  
Laboratory classes: 1h  
Self study: 10h

### Description:
- Failure Indicators
- Analysis in Time domain, Frequency domain and Time-Frequency domain
- Condition Monitoring

## Module 9: Embedded systems for condition monitoring
**Learning time:** 15h  
Theory classes: 2h  
Laboratory classes: 3h  
Self study: 10h

### Description:
- Smart sensors and signal processing
- Implementation alternatives
- Sensor integration in communication networks

## Module 10: System diagnosis
**Learning time:** 17h  
Theory classes: 5h  
Laboratory classes: 2h  
Self study: 10h

### Description:
- Condition assessment
- Artificial Intelligent applied to system diagnosis
- Feature reduction and extraction
- Data fusion and classification algorithms
## Module 11: Integration of diagnostic modules with factory management systems

### Description:
- Global plant diagnosis and prognosis
- MIMOSA standard for maintenance information exchange
- Integration of maintenance modules in MES and ERP systems
- Decision Support Systems, DSS

### Learning time: 12h
- Theory classes: 3h 30m
- Laboratory classes: 1h
- Self study: 7h 30m
## Presentation of Subject Contents for the Diagnostic Block

**Description:**
The activity follows the model of participatory class exposure. The course content will be presented and discussed in classroom, with interaction and participation of students in the form of questions and interventions related to the material, applications or roadmaps for the future technology.

**Support materials:**
Class notes and references

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td><strong>(ENG) EXAMEN 1</strong></td>
<td>2h</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td><strong>(ENG) EXAMEN 2</strong></td>
<td>1h</td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td><strong>(ENG) ENTREGA PARCIAL 1 PROJECTE</strong></td>
<td>0h 30m</td>
<td>Laboratory classes: 0h 30m</td>
</tr>
<tr>
<td><strong>(ENG) ENTREGA PARCIAL 2 PROJECTE</strong></td>
<td>0h 30m</td>
<td>Laboratory classes: 0h 30m</td>
</tr>
<tr>
<td><strong>(ENG) PRESENTACIÓ FINAL PROJECTE</strong></td>
<td>3h</td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td><strong>(ENG) SESSIONS DE TEORIA</strong></td>
<td>55h</td>
<td>Theory classes: 20h, Self study: 35h</td>
</tr>
<tr>
<td><strong>(ENG) TUTORIES SEGUIMENT PROJECTE</strong></td>
<td>63h</td>
<td>Theory classes: 5h, Self study: 45h, Laboratory classes: 13h</td>
</tr>
<tr>
<td><strong>PRESENTATION OF SUBJECT CONTENTS FOR THE DIAGNOSTIC BLOCK</strong></td>
<td>40h</td>
<td>Theory classes: 12h 30m, Self study: 27h 30m</td>
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</table>
EXPERIMENTAL LABORATORY FOR THE DIAGNOSTIC BLOCK

Description:
The activity is related to laboratory analysis and the development of experimental methodologies. During the lessons, several experimental practices will be carried out through the use of laboratory facilities: MATLAB / Simulink, DSP based systems.
Each practice consists of three parts: previous preparation by students, execution according to the sequence set, and the writing of the final report.

Support materials:
Manuals for the practical exercises and for the necessary equipment

| Hours: 19h 30m |
| Laboratory classes: 7h |
| Self study: 12h 30m |

EXAMS AND PRESENTATIONS FOR THE DIAGNOSTIC BLOCK

Description:
Written tests and oral presentations for assessment of student knowledge and skills

| Hours: 3h |
| Theory classes: 3h |

Qualification system

It is based on a written test (exam), the evaluation of the practices of the subject and the evaluation of a subject work that will include a task of partial evaluation and the final presentation.

The weights of each evaluation act are the following:

Practices of the subject: 30%

Partial delivery of the work (10%): delivery in a date to be determined

Final presentation of the work (25%): Oral defense of the work developed in front of the teaching staff and the rest of students of the subject. Delivery of the final documentation. To be carried out in accordance with the academic planning of the course and with the possibility of recovery (completing and improving the work in case of unsatisfactory results) during the final examination period.

Written test: 35% to be done during the final exam period

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.
220617 - Diagnosis and Power Storage

Bibliography

Basic:


Others resources:

- Audiovisual material
  - Apunts de classe

- Computer material
  - Programari simulació