

Course guide

220617 - 220617 - Diagnosis and Power Storage

Last modified: 02/04/2024

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering	
Teaching unit:	710 - EEL - Department of Electronic Engineering.	
Degree:	MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).	
Academic year: 2024	ECTS Credits: 5.0	Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: JUAN ANTONIO ORTEGA REDONDO

Others: JOSÉ LUIS ROMERAL MARTÍNEZ

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.
6. 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.

Basic:

2. Improve technical communication of results.
3. Improve self-learning capacity

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

STUDY LOAD

Type	Hours	Percentage
Hours large group	31,0	24.80
Self study	80,0	64.00
Hours small group	14,0	11.20

Total learning time: 125 h

CONTENTS

(ENG) Module 1: Introduction

Description:

Justification of Energy Storage Systems (ESS). General overview of different kind of systems. Main features (capacity, energy densities, specific cost, etc). Applications.

Specific objectives:

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

Full-or-part-time: 5h

Theory classes: 2h

Self study : 3h

(ENG) Module 2: Electrochemical Systems. Batteries

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.

Full-or-part-time: 5h

Theory classes: 2h

Self study : 3h

(ENG) Module 3: Fuel Cells

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.

Full-or-part-time: 5h

Theory classes: 2h

Self study : 3h

(ENG) 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.

Full-or-part-time: 8h

Theory classes: 3h

Self study : 5h

(ENG) 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.

Full-or-part-time: 8h

Theory classes: 3h

Self study : 5h

(ENG) 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.

Full-or-part-time: 31h 30m

Theory classes: 3h 30m

Laboratory classes: 7h

Self study : 21h

Module 7: Industrial Maintenance Strategies

Description:

o Corrective, preventive and predictive Maintenance

o Types of failures: Mechanical and Electrical

Full-or-part-time: 3h 30m

Theory classes: 1h

Self study : 2h 30m

Module 8: Process variables. Failure Indicators

Description:

- o Failures Indicators
- o Analysis in Time domain, Frequency domain and Time-Frequency domain
- o Condition Monitoring

Full-or-part-time: 15h

Theory classes: 4h

Laboratory classes: 1h

Self study : 10h

Module 9: Embedded systems for condition monitoring

Description:

- o Smart sensors and signal processing
- o Implementation alternatives
- o Sensor integration in communication networks

Full-or-part-time: 15h

Theory classes: 2h

Laboratory classes: 3h

Self study : 10h

Module 10: System diagnosis

Description:

- o Condition assessment
- o Artificial Intelligent applied to system diagnosis
- o Feature reduction and extraction
- o Data fusion and classification algorithms

Full-or-part-time: 17h

Theory classes: 5h

Laboratory classes: 2h

Self study : 10h

Module 11: Integration of diagnostic modules with factory management systems

Description:

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

Full-or-part-time: 12h

Theory classes: 3h 30m

Laboratory classes: 1h

Self study : 7h 30m



ACTIVITIES

(ENG) EXAMEN 1

Full-or-part-time: 2h

Theory classes: 2h

(ENG) EXAMEN 2

Full-or-part-time: 1h

Theory classes: 1h

(ENG) ENTREGA PARCIAL 1 PROJECTE

Full-or-part-time: 0h 30m

Laboratory classes: 0h 30m

(ENG) ENTREGA PARCIAL 2 PROJECTE

Full-or-part-time: 0h 30m

Laboratory classes: 0h 30m

(ENG) PRESENTACIÓ FINAL PROJECTE

Full-or-part-time: 3h

Theory classes: 3h

(ENG) SESSIONS DE TEORIA

Full-or-part-time: 55h

Self study: 35h

Theory classes: 20h

(ENG) TUTORIES SEGUIMENT PROJECTE

Full-or-part-time: 63h

Self study: 45h

Theory classes: 5h

Laboratory classes: 13h



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

Material:

Class notes and references

Full-or-part-time: 40h

Self study: 27h 30m

Theory classes: 12h 30m

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.

Material:

Manuals for the practical exercises and for the necessary equipment

Full-or-part-time: 19h 30m

Self study: 12h 30m

Laboratory classes: 7h

EXAMS AND PRESENTATIONS FOR THE DIAGNOSTIC BLOCK

Description:

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

Full-or-part-time: 3h

Theory classes: 3h

GRADING 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.

BIBLIOGRAPHY

Basic:

- Brunet, Yves. Energy storage [on line]. Hoboken: Wiley, 2011 [Consultation: 17/06/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1143636>. ISBN 9781848211834.
- Holmberg, Kenneth. E-maintenance. London: Springer, 2010. ISBN 9781849962049.
- Isermann, Rol. Fault-diagnosis applications: model-based condition monitoring: actuators, drives, machinery, plants, sensors and fault-tolerant systems. Berlin: Springer, 2011. ISBN 9783642127663.
- Fernández Cabanas, M. [et al.]. Técnicas para el mantenimiento y diagnóstico de máquinas eléctricas rotativas. Barcelona: Marcombo, 1998. ISBN 9788426711663.
- Ben-Daya, M. [et al.]. Handbook of maintenance management and engineering. New York: Springer, 2009. ISBN 9781848824713.

RESOURCES

Audiovisual material:

- Apunts de classe

Computer material:

- Programari simulació