DEGREE CURRICULUM

INDUSTRIAL INSTRUMENTATION

Coordination: CLARIA SANCHO, FRANCISCO

Academic year 2017-18

Subject's general information

Subject name	INDUSTRIAL INSTRUMENTATION
Code	14542
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</th><th>Modality</th></tr><tr><td>Master's Degree in Industrial Engineering</td><td>2</td><td>OPTIONAL</td><td>Attendance-based</td></tr></table>
ECTS credits	6
Groups	1GG
Theoretical credits	3
Practical credits	3
Coordination	CLARIA SANCHO, FRANCISCO
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	(40%) Classroom (60%) Homework
Important information on data processing	Consult this link for more information.
Language	Language Usage percentage Spanish 20 % English 50 % Catalan 30 %
Distribution of credits	1 ECTS credit equals 10 hours of class + 15 hours work autonomous
Office and hour of attention	Office 1.06, EPS

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CLARIA SANCHO, FRANCISCO	claria@diei.udl.cat	0	
RIBO PABLO, JOSE	jribo@diei.udl.cat	6	arrange tutoring by e-mail

Subject's extra information

It is intended that the acquisition of knowledge applied to the instrumentation complement automation and control training and studied in other subjects of the degree and the master,within the context of electronic technology.

Since the advanced industrial instrumentation is closely linked with electronics and control technology, it would be the future master industrial engineer acquire skills process control through troubleshooting sessions organized practices
theoretically justified to facilitate understanding of a wide variety of difficult concepts fully assimilated by the usual theoretical presentations.

This subject is particularly important experimentation and design of real prototypes. As recognized publications support means will be used in the field of instrumentation and as technical manuals and manufacturer of components datasheet.

PRACTICES AT EPS

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

Although this is an optional subject in the Masters, the year of Industrial Engineering, in their various fields, is closely linked to the actual measurement of physical variables, conditioning signal and its application on the mechanisms of action.
Future superiors through the course technicians will be able to:

- **Knowing** the physical principles of operation of a wide variety of transducers, of systems, signal conditioning, final control elements and knowing use.
- **Acquire** the ability to design and interpret instrumentation systems according to the rules applicable technical and technical manuals manufacturers.
- **Acquire** the ability to perform correct measurements, calculations consistent,and draft technical reports structured correctly (according to UNE) with clear and rigorous conclusions.
- **Acquire** the necessary skill handling the literature, publications, documentation and technical specifications of manufacturers of instrumentation systems.
- **Knowing** the characteristics of real-time systems and their application for solving problems.

Competences

General competencies set in Order CIN / EPS 311/2009 and EPS criteria.

- CG3 Capacity to convey information, ideas, problems and solutions both to a specialised and no specialised public.
- CG4 Capacity to conceive, design and implement projects and/or provide new solutions, using the tools that the engineering offers.
- CG13 Knowledge, understanding and capacity to apply the necessary legislation in order to practice the profession of Industrial Engineer.

Specific competencies set in Order CIN / 311/2009

- CE7 Capacity to design electronic and industrial instrumentation systems.
- CE8 Capacity to design and project automated production and advanced process control systems.

Cross-disciplinary competences approved by the Plenary Commission of the Degrees of Industrial Engineering, Computer Engineering and Building Engineering, gathered in June 16th, 2008.

- CT1 Appropriate skills in oral and written language.
- CT2 Command of a foreign language.

Subject contents

THEME 1

- Measurement of physical quantities.
- Specialized techniques for signal conditioning.
- Classical definitions instrumentation: accuracy, repeatability, dead zones, hysteresis.
- Virtual instrumentation

THEME 2

- A / D and D / A conversion.
- Characterization of processes.
- Data acquisition. Architecture. virtual instrumentation.
- Data acquisition. real applications. Applications to analog circuits and digital filtering.
- Isolation of signals with optical or galvanic elements and protection elements. Multiplexing.

THEME 3

- Fundamentals of physics and its application to the technologies of preparing materials for sensor construction.
- Measuring devices, transducers, sensors and passive sensors. Classificationsensors (assets, liabilities, analog, digital, discreet, intelligent, integrated). variables physical and conditioning, temperature, pressure, flow, level, movement and distances electrical quantities standardized by organizations such as IEC, IEEE, ISO, ISA or DIN.
- Standard elements of measurement systems (patterns, instrument calibration measurement and traceability)

THEME 4

- Industrial sensors, resistive, variable reactance, generators sensors,amplification, linearization and signal transmission. Inductive sensors, capacitive, ultrasonic, piezoelectric, photoelectric and optical fibers.
- Strategies measuring weak signals. bioelectric signals.
- Amplification circuits. final control elements. Valves and mechanical actuators,pneumatic, hydraulic and electric.

THEME 5

- Instrumentation systems modulated (amplitude, frequency or phase). Baseband and spectrum shift. DC elimination of defects. analog multipliers. ties PID in real time. Time and frequency specifications. Tuning controllers.
- Strategies measuring weak signals. bioelectric signals.

THEME 6

- Instrumentation buses and interface circuits. Application of electromagnetic theory Electromagnetic compatibility. Systems Interferències.
- Problemes conventional operating. Operating systems.
- Control and process monitoring in time real.

Methodology

- **Lectures**: In the lectures the contents of the subject are presented by teachers without the active participation of students.
- **Colloquia:** activities consist exchange of views among students under the direction of teacher.
- **Group work:** Learning activity to be conducted through collaboration between members of a group.
- **Written work**: consisting of the submission of a written document activity.
- **Problem-based learning,** as problem-based learning method of promoting from selected real-life problems learning is used.
- **Troubleshooting:** In the problem-solving activity, the teacher presents a complex issue that students must solve, either working individually or in teams.
- **Project development:** active teaching methodology that promotes learning from the realization of a project idea, design, planning, development and evaluation.
- **Practices:** Let you apply and configure a practical level, the theory of a field of knowledge in a particular context.

Development plan

Week	Methodology	Temary	Presential hours	Hours of autonomous work
1-2	Master class	THEME 1	8	12
3	Practical lesson	THEME 1	4	6
4-5	Master class	THEME 2	8	12
6	Practical lesson	THEME 3	4	6
7-8	Master class	THEME 3	8	12
9	written exam	THEME 1-2-3	2	
10-11	Master class	THEME 4	8	12
12	Practical lesson	THEME 4	4	6
13-14	Master class	THEME 5-6	8	12
15	Practical lesson	THEME 5-6	4	6
16	written exam	THEME 4-5-6	2	

Evaluation

Evaluation activities	%	Dates	C/V (1)	I/G (2)	Remarks
PA1: Written exam	30	Week 9	C	I	1 or more points
PA2: Written exam	50	Week 17	C	I	2,5 points or more

PA3: Proposed work	20	Before each evaluation	C	I	
PA5: Voluntary work			V		Could increase by 10% the final evaluation note
PA6: Recovery exam		Week 19			

C: Compulsory; V: Voluntary

I: Individual; G: Group

- For proper monitoring of the subject it is essential to attendance at classes. Absences must be justified.
- Student participation in class is permanent. Writing reports related to the acquired knowledge and the contrast with the results obtained, will weigh 20% of the final grade. During the course four works are proposed.
- Clarity of concepts, synthesis capacity, quality of reports and conclusions should be considered.
- Personal initiative of the student and the contribution of new ideas can lead to an increase of 10% on the final grade.

Bibliography

Currently the literature in instrumentation is very extensive and quality.

Here are just a few publications that have seemed appropriate to facilitate monitoring of the subject.

- Handbock of Modern Sensors Physics, Designs and Applications. Jacob Fraden, Springer.
- Data Acquisition ans Signal Processing for Smart Sensors. Kirianaki et al. Wiley
- Suport documental de National Instruments.
- Introductión to Instrumentation, sensors, and Process Control, William C. Dunn. Artech House.
- Intrumentación electrònica. Pèrez Garcia et al. Thomson.
- Adquisiciòn y distribución de señales. Pallás. Marcombo.
- Handbook of Valves and actuators. Nesbitt. B/H
- Instrumentación Industrial. Creus. Marcombo.
- Process Control Instrumentation Technology. Johnson. Prentice Hall
- Principles of Measurement Systems. Bentley. Pearson.
- Measurement Systems and Sensors. Waldemar. Artech House
- Data Acquisition Toolbox. User's Guide. Matlab. MathWorks.
- Real-Time Windows Targer. User's Guide. The MathWorks