Experimental techniques in thermal engineering

Academic Year: (2023 / 2024) **Review date: 24/04/2023 10:07:12**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: GOMEZ HERNANDEZ, JESUS

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

OBJECTIVES

Competences and skills that will be acquired and learning results

- Design a data acquisition system to fit some specific thermal process application.
- Measurement of errors and uncertainty associated to industrial monitoring.
- Identify the most suitable signal analysis methodology to recover information from measured time series.
- Understand the control strategies used in conventional control systems found in industrial thermal processes.
- To characterize a control loop using the dynamic analysis by transient response.
- Understand the measurement techniques employed in renewable energies, focusing on concentrating solar technologies.

Learning outcome
At the end of the course program the students will be able to design a monitoring and control system to fit a specific industrial or research application within the framework of thermal processes. The design should include the description of the instrumentation to fulfill the minimum data acquisition requirements of the control systems, the control strategy to be used, and the digital signal processing to be applied on the collected signals.

Methodology
Teaching will be focused on applyied knowledge by performing several laboratory lessons and working on two industrial projects that will be solved in class (aiming heliostats and controlling an industrial process).

DESCRIPTION OF CONTENTS: PROGRAMME

1- Introduction, measurement errors and uncertainty
2- Data acquisition systems and signal processing.
3- Industry sensors: measurement techniques (temperature, pressure, level, ...).
4- Conventional control feedback systems for thermal processes.
5- Tunning control systems.
6- Advanced control systems for thermal processes.
7- Project 1: Experimental project aiming and controlling Fresnel heliostats. Experimental work with a lab-scale prototype and solving the project during the class sessions.
8- Project 2: Control simulatoin of an industrial process.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures solving application examples and covering the main topics described within the course program. (1 ECTS)
- Problem solving and case study lectures, where some issues are addressed from a practical point of view (1,5 ECTS).

- Laboratory and practical sessions, where the student can apply the concepts learn and face the monitoring and control solution adopted in real applications. (0.5 ECTS)

ASSESSMENT SYSTEM

% end-of-term-examination/test:	10
% of continuous assessment (assigments, laboratory, practicals…):	90

The continuous evaluation percentage is 100%, 10% is due to the Final Exam, while a 90% corresponds to the evaluation of reports and guided projects. Final exam will be held online through Aula Global.

In brief:
- Technical reports about the laboratory lessons (40%):
  -> Laboratory 1: Signal adquisition using Arduino and Python = 10%
  -> Laboratory 2: Signal treatment using Matlab = 10%
  -> Laboratory 3: PID tunning = 10%
  -> Laboratory 4: Advanced control = 10%

- Applied projects (50%):
  -> Proyect 1: Data adquisition and control of a Fresnel heliostat using Arduino = 25%
  -> Proyect 2: Control simulation of an industrial process = 25%

- Continuous evaluation through an online exam (10%):
  -> Online exam with true/false questions and/or multiple choice questions.

The extraordinary evaluation will be carried out through the evaluation of the reports and guided projects, with a total percentage of 100%.

BASIC BIBLIOGRAPHY

- Alan S. Morris and Reza Langari Measurement and Instrumentation. Theory and Application, Elsevier Inc, 2012

- PPL Regtien, F van der Heijden, MJ Korsten and W Olthius Measurement Science for Engineers, Elsevier Ltd, 2004

- Wolfgang Altmann, David Macdonald, and Steve Mackay Practical Process Control for Engineers and Technicians, Elsevier Ltd., 2005