SUBJECT TEACHING GUIDE

G1701 - Dynamics and Control of Chemical Processes

Degree in Chemical Engineering

Academic year 2021-2022

1. IDENTIFYING DATA					
Degree	Degree in Chemical Engineering			Type and Year	Compulsory. Year 3
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Process Design, Management and Operation.Simulation, Dynamics, Control and Instrumentation of Chemical Processes. Analysis, Design and Optimisation of Processes and Products Module: Compusory Training Industrial Chemistry				
Course unit title and code	G1701 - Dynamics and Control of Chemical Processes				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIAS QUIMICA Y BIOMOLECULAR
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3.1 LEARNING OUTCOMES
- To be able to apply the chemical engineering fundamentals to the preliminary design of chemical processes
- To be able to analyze the dynamic response of chemical processes , using both mathematical modelling and empoirical data analysis methodologies
- To analyze and compare piping and instrumentation process diagrams, at a basic engineering level
- To be able to select the process instruments, according to the needs of chemical and biotechnological processes
- To be able to design automatic control systems, to be applied to the needs of the chemical industry

4. OBJECTIVES

Process control has become increasingly important in the process industries, since it is critical in the development of more flexible and more complex processes for manufacturing high added value products. Consequently, chemical engineers need to master this subject in order to be able to design and operate modern plants. The concepts of dynamics, feedback and stability are also important for understanding many complex systems of interest to chemical engineers, such as in bioengineering and in general processes in which transformation of matter occurs, emphasizing dynamic behavior, physical and empirical modeling, measurement and control technology, basic control concepts and advanced control strategies. The course provides an appropriate balance of dynamics and control theory and practice, the latter is developed through case studies and one mini group project.
Part I provides and introduction to process control and in-depth discussion of dynamic process modeling, based on basic principles of mass and energy conservation. Part II is concerned with the analysis of the dynamic (unsteady-state) behavior of processes. In addition, the important topics of empirical models and their development from plant data are presented. Finally, Part III addresses the fundamental concepts of feedback and feedforward control. The topics include an overview of the process instrumentation that is necessary to implement process control: chemical composition, pressure, temperature, flowrates, final control elements.

6. COURSE ORGANIZATION

CONTENTS	
1	PART I. INTRODUCTION TO CHEMICAL PROCESS CONTROL Chapter 1. Introduction to process control. Representative examples. Classification of process variables. Classification of process control strategies. Chapter 2. Theoretical models of chemical processes. Fundamentals of dynamic models. Representative examples
2	PARTR II. DYNAMIC BEHAVIOUR OF CHEMICAL PROCESSES Chapter 3. Linearization of non-linear models. Transfer functions models. Representative examples. Chapter 4. Analysis of the dynamic behavior of first and second order processes. Chapter 5. Dynamic response of more complex systems. Dead time, inverse response, higher order dynamics, interaction, multiple input-multiple output MIMO systems. Chapter 6. Development of dynamic models from empirical process data.
3	PART III. FEED BACK AND FEED FORWARD CONTROL SYSTEMS Chapter 7. Feedback control. Types of feedback controllers. Chemical process intrumentation. Sensors, transducers, and final control elements. Chapter 8. Transfer functions of the feedback control loop. analysis of the dynamic behavior of the feedback controlled response. stability of the controlled response. Chapter 9. Design and tunning of PID controllers. Model based design methods. Design criteria based on minimizing the integral error. Enpirical methods. Chapter 10. Feedforward control. Desing of feedforward controllers based on dynamic models.Configurations of feedforward-feedback controllers.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Exam about contents of Part I and Part II	Written exam	No	Yes	35,00
Exam about conternts of part III	Written exam	Yes	Yes	35,00
Reports of results of Computer practices. Individual project on process instrumentation	Work	No	Yes	30,00
TOTAL				100,00

Observations

Continuous evaluation is based on two partial tests and a portfolio. The portfolio will consist of reports of computer practices and one instrumentation project. To pass the subject through continuous evaluation it is necessary to attend practical classes a minimum of 80% and deliver on time the results reports. Attendance to computer practices is mandatory in order to be able to deliver the report of each practice. The parts not passed in the continuous evaluation process may be recovered in the ordinary and extraordinary calls established by the Centre. In the case of a sanitary alert that makes it impossible to carry out the assessment in person, the evaluation methodologies may be adapted to the available telematics means.

Observations for part-time students

In accordance with article 24 of the REGULATION OF the EVALUATION PROCESSES OF THE UNIVERSITY OF CANTABRIA, the specific procedures that guarantee in each case the evaluation of the same knowledge and competences to be acquired by students full-time will be established.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

1. Process Dynamics and Control. 4th Edition. D.E. Seborg, T.F. Edgar, D.A. Mellicahamp, F.J. Doyle. John Wiley & Sons, 2017.
2. Chemical Process Control: An introduction to Theory and Practice. G. Stephanopoulos. Prentice Hall, 1984
3. Instrumentación y Control de Plantas Químicas. P. Ollero de Castro, E. Fernandez Camacho. Síntesis, 2012.