SUBJECT TEACHING GUIDE

G784 - 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	G784 - Dynamics and Control of Chemical Processes				
Number of ECTS credits allocated	6	Term	Semester based (2)		
Web					
Language of instruction	English		Mode of delivery	Face-to-face	

Department	DPTO. INGENIERIAS QUIMICA Y BIOMOLECULAR
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3.1 LEARNING OUTCOMES

- 1. To be able to apply the fundamentals of chemical engineering to preliminary design of chemical processes
2. To be able to analyse the dynamic response of chemical processes, using methematical modelling methodologies
3. To be able to analyse, assess and compare flow-sheet diagrams and P&I diagrams at basic engineering level
4. To be able to compare and select process intruments, to meet the typical request of mass transformation processes
5. To be able to design automatic control systems according to the needs of chemical engineering

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 One. Introduction to Process Control 1. Introduction to process control. Illustrative example - A blending process. Classification of Process Control Strategies 2. Theoretical models of Chemical processes. General modeling principles for dynamic process models. Representative examples
2	Part Two. Dynamic behavior of processes 3. Linearization of non-linear models. Transfer function models. An illustrative example: a continuous blending system 4. Dynamic behavior of first-order and second-order processes 5. Dynamic response characteristics of more complicated processes: time delays, higher order systems, interacting and non-interacting processes, multiple input-multiple output processes 6. Development of empirical models from process data
3	Part Three. Feedback and feedforward control 7. Control system instrumentation. Sensors and transducers. Final control elements 8. Feedback control. Feedback controllers. Close loop transfer functions. Dynamic behavior and stability of close loop response 9. PID controller design. Model - based design methods. Tuning relations based on integral error criterion. strategies for the enhancement of PID control. 10. Feedforward and ratio control. Feedforward controller design based on dynamic models. Configurations for feedforward-feedback control

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Written exam on the contecnts of Parts I and II	Written exam	No	Yes	35,00
Written exam on the contents of Part III	Written exam	Yes	Yes	35,00
Reports of the computer sessions. Individual project on process instrumentation.	Work	No	Yes	30,00
TOTAL				100,00

Observations

The evaluation of the course is based in two partial exams and the portafolio. For continuous evaluation, it is compulsory to attend at least 80% of the practical computer sessions, and deliver the reports as defined in the time schedule. Those students having failed any part of the continuous evaluation process can resit in the ordinary and/or extraordanary final evaluation periods. Should a health alert make impossible to do the exams in person, the evaluation methodologies will be adapted to the available telematic channels.

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, in coordination with the student and the coordinator of the study program.

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.