COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Chemical Process Control	CHBE 541	1 or 2	3 + 0	3	10

Prerequisites	None

Language of Instruction	English
Course Level	Graduate Degree
Course Type	Technical Elective
Course Coordinator	Assist. Prof. Dr. M. Oluş Özbek
Instructors	Assist. Prof. Dr. M. Oluş Özbek
Assistants	To be assigned
Goals	The aim of this course is to provide students with an advanced knowledge of modelling and control of chemical processes.
Content	1) Laplace transforms, Transfer functions, Block diagrams 2) Development of Empirical Dynamic Models from Process Data 3) MATLAB-Simulink Control systems toolbox 4) Dynamic Response Characteristics of More Complicated Processes 5) PID Controller Design, Tuning, and Troubleshooting 6) Frequency Response Analysis and Control System Design 7) Feedforward and Ratio Control 8) Enhanced Single-Loop Control Strategies 9) Multiloop and Multivariable Control 10) Digital Sampling, Filtering, and Control 11) Model Predictive Control

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Ability to use and apply Laplace transforms, transfer functions, block diagrams for system models	1,8	1,2,3	A,C
2) Ability to development of empirical dynamic models of simple processes using process data	1,5,7,8	1,2,3	A,C
3) Ability to use MATLAB-Simulink (control systems toolbox) to simulate the open-loop and closed-loop (feedback) responses of the systems	1,5,7,8	1,2,3,9	A,C
4) Ability to develop and analyze the dynamic responses of more complicated processes	1,8	1,2,3	A,C
5) Ability and in depth knowledge on the PID controller design, tuning, and troubleshooting	1,7,8	1,2,3,9	A,C
6) Ability and in depth knowledge on the frequency response analysis and control system design	1,8	1,2,3	A,C
7) Ability and in depth knowledge on the construction of feedforward and ratio control systems	1,8	1,2,3,9	A,C
8) Ability to develop enhanced single-loop control strategies	1,7,8	1,2,3,9	A,C
9) In depth knowledge on the multiloop and multivariable control	1,8	1,2,3,9	A,C
10) In depth knowledge on the digital sampling, filtering, and control of continuous systems	1,7,8	1,2,3,9	A,C

11) In depth knowledge on the model predictive control strategies	1,5,7,8	1,2,3,9	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation
Assessment Methods:	A: Testing, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Laplace transforms, Transfer functions, Block diagrams	Textbook-Lecture Notes
2	Development of Empirical Dynamic Models from Process Data	Textbook-Lecture Notes
3	Introduction to MATLAB-Simulink Control Systems Toolbox	Lecture Notes
4	Dynamic Response Characteristics of More Complicated Processes	Textbook-Lecture Notes
5	PID Controller Design, Tuning, and Troubleshooting	Textbook-Lecture Notes
6	MIDTERM EXAM 1	Textbook-Lecture Notes
7	Frequency Response Analysis and Control System Design	Textbook-Lecture Notes
8	Feedforward and Ratio Control	Textbook-Lecture Notes
9	Enhanced Single-Loop Control Strategies	Textbook-Lecture Notes
10	Multiloop and Multivariable Control	Textbook-Lecture Notes
11	MIDTERM EXAM 2	Textbook-Lecture Notes
12	Digital Sampling, Filtering, and Control	Textbook-Lecture Notes
13	Digital Sampling, Filtering, and Control Model Predictive Control	Textbook-Lecture Notes
14	Model Predictive Control	Textbook-Lecture Notes

RECOMMENDED SOURCES	
Textbook	"Process Dynamics and Control 3rd Ed.", Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, III, John Wiley & Sons (Asia), 2011
Additional Resources	"Introduction to Process Control", J. A. Romagnoli, A. Palazoglu, CRC Press, 2006 "Chemical Process Control: An Introduction to Theory and Practice", George Stephanopoulos, Prentice Hall, 1984 "Michigan Chemical Engineering Process Dynamics and Controls Open Textbook", https://controls.engin.umich.edu/wiki/index.php/Main_Page

MATERIAL SHARING
Documents, Assignments, Lecture Notes

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	50
Homeworks	5	20
	Total	**70**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
	Total	**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					X	
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X	
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.						
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.						
5	Understand a genuine research process independently, design, apply and carry through; manage this process.						
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.						
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					X	
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					X	
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and written.						
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.						

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 12x Total course hours)	13	3	39
Hours for off-the-classroom study (Pre-study, practice)	14	10	140
Midterm examination	2	(10+2)	24
Homework	5	6	30
Final examination	1	(15+3)	18
Total Work Load			251
Total Work Load / 25 (h)			10.0
ECTS Credit of the Course			10