Identification	**Subject**	CHE 401 Process Control System 6 ECTS
	Department	Chemistry and Chemical Engineering
	Program	Undergraduate
	Term	Spring 2024
	Instructor	Azar Tapdigzade
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	Phone	+994 516320176 +994 772553340
	Classroom/hours	11 Mehseti str. (Neftchilar campus) 202N/ 18:40 - 21:00
Prerequisites	• Engineering Mathematics • Knowledge of how to use of charts and tables • Process Industries A/B/C	
Language	English	
Compulsory/Elective	Required	
Required textbooks and course materials	Main textbooks (References): • Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016 • Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016.	
Course outline	Controlling chemical and physical processes is a topic of key importance for process engineers. The subject underpins not only plant safety and cost, but also product yield and quality, as well as environmental considerations. An effective control scheme depends on understanding the dynamic behavior and physical characteristics of a process. Thus, being able to model processes is an essential requirement of Process Control. This module aims to introduce core topics in Process Control, demonstrate the utility of mathematics to the development of process models (for typical unit operations) and introduce techniques to solve these models.	
Course objectives	• Review and outline the need for Process Control, as well as the need to model, not only individual items of equipment, but also overall processes. • List the individual elements needed to implement a control loop. • Review the elements of feedback control. • Explain and derive transfer functions for the following controller action terms: Proportional (P), Integral (I) and Derivative (D). • Compare and contrast basic analogue and digital forms of PID controller. • Explain and derive practical improvements to both analogue and digital PID controller forms. • Differentiate how control loops can be represented using different types of diagrams. • Review measuring devices, final control elements, controllers and discuss their functionality within the framework of a control loop.	
Learning outcomes	Having worked through this chapter the students will develop knowledge of: • Fundamental aspects of process control • Principle techniques to measure temperature, pressure, flowrate and liquid level • Understanding the use of P&ID to communicate control strategies • Criteria used to select valves for controlling flow of material • Fundamentals applied to pressure relief systems	
Teaching methods	**Lecture**	x

<table>
<tr><td></td><td colspan="2">Problem-based learning (Real industry examples)</td><td>x</td></tr>
<tr><td></td><td colspan="2">Simulation Software</td><td>x</td></tr>
<tr><td rowspan="7">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td>Week 7th</td><td>25</td></tr>
<tr><td>Quiz</td><td>Week 4th & 11th</td><td>20</td></tr>
<tr><td>HYSYS Assignment</td><td>Week 13th</td><td>10</td></tr>
<tr><td>Topic Presentation</td><td>Week 14th</td><td>5</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">

Preparation for class
The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions
Assessment
Midterm will be in the middle of term which contains 25% of total mark. Students will be evaluated based on half term learning that help them to summarize all knowledge.
Before and after midterm, quizzes will be arranged to get students be focused and recall what has been taught within 3-4 weeks and each quiz will give 10, 20 marks in total.
Presentations will be not only at week 14, but also during the semester on different topics to improve students` skills to investigate, present and learn more about chemical engineering industry. But only presentation at week 14 will be assessed by 5 percent of total mark.
Hysys Assignment will be evaluated by 10% of total mark, by Hysys students understand simulations of real industry cases based on what they have learned within the course.
Withdrawal (pass/fail)
This course strictly follows grading policy of the School of Engineering and Applied Science. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.
Cheating/plagiarism
Plagiarism and Cheating of any kind on an examination, quiz, or project will lead to assignment cancellation. In this case, the student will automatically get zero (0), without any considerations.
Professional behavior guidelines
The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.
Ethics
Students should not arrive in late to class. All electronic devices must be silenced and stowed during class.

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	Tentative Schedule	
Weeks	**Topics**	**Textbook/Assignments**
1	Fundamentals of Process Control (Basıc Regulatory Control System Structure)	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1, page 3-21 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 1, page 5-23
1	Fundamentals of Process Control (Elements Of Control Systems)	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1, page 5-23
2	Piping and Instrumentation Diagrams	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1, page 18-36 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 1, page 18-29
2	The Control Loop	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1
3	Laplace Transforms/ Solution of ODEs Using Laplace Transforms	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1
3	Development of Transfer Functions/ Linear First Order Differential Equations	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 1
3	Linear Second Order Differential Equations	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 2 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 2, page 5-29
4	Feedback Control	• Heriot-Watt University, Unit Operations A (Control Element), Edinburgh EH14 4AS, 2016, topic 2

4	Feedback Control (Different Forms of PID Controller and Their Applications)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 2
4	Feedback Control (Digital Controllers)	**Assignment 1**
5	Enhanced Control (Feedforward Control)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 3 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 3, page 5-25
5	Enhanced Control (Cascade Control)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 4, page 4-18 • Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 3, page 26-33
6	Process Control System Design (Structure of Industrial Control Systems)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 3
6	Process Control System Design (Degrees of Freedom Analysis/ Energy Balance Controls)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 4
Midterm Exam		
7	Temperature Measuring Systems	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 4
7	Pressure Measuring Systems	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 4
8	Flowrate Measuring Systems	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 4
8	Liquid Level Measuring Systems	• Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 4, page 6-33

8	Density Measurements	• Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 4, page 6-33
9	Controllers	• Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 5, page 5-36
10	Control Valves – Final Control Elements	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 5, page 5-36
11	Pressure Relief and Flaring	**Assignment 2**
12	Plantwıde Controls (Locatıon of Throughput Control System)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 5
12	Plantwıde Controls (Improved Operabılıty)	• Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 5, page 37-42
13	Plantwıde Controls (Inventory Control)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 5
13	Plantwıde Controls (Energy Balance Controls)	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 5
14	Stabılıty Analysıs And Tunıng	• Heriot-Watt University, Unit Operations A (Process Modelling), Edinburgh EH14 4AS, 2016, topic 5
14	Stabılıty Analysıs And Tunıng (Closed-Loop Transfer Functıon)	• Oil and Gas Process Engineering training guide (BP challenger program), Process Control and Instrumentation, Chapter 11, Edinburg, 2016, topic 6, page 3-18
15	Final Presentation	
Final Exam		