CH 544	Process Control	Class: 4th	Mandatory

Teaching scheme: 3 hours lecture, 1 hour tutorial per week and laboratory for one semester **Credits:** 7

Course Description:

This course cover the fundamentals of process modeling, dynamics, and feedback control. Linear control theory and simulation languages. Application of Laplace transforms and frequency domain theory to the analysis of open-loop and closed-loop process dynamics. Stability analysis and gain/phase margins. Controller modes and settings. Design of systems for control of level, flow, heat exchangers, reactors and elementary multivariable systems.

Objectives: To provide the background of Identify, formulate and solve linear chemical process dynamics problems. Formulate and solve an approximate linear model to a nonlinear process. Choose a control strategy for a process. Distinguish between feedforward and feedback control strategies. Choose the appropriate control action (P, PI, PID) for a particular process. Tune a P, PI, or PID controller. Identify advanced control strategies and apply them in appropriate situations. Develop block diagrams from process information. Analyze the stability of a dynamic system

Learning outcome:

By the end of the course the student should be :

- Analyze block diagrams.
- be able to formulate dynamic models for simple processes and be able to solve them to produce responses to step inputs.
- understand, at a practical level, a number of modern control techniques. Analyze block diagrams.
- Use process control vocabulary appropriately.
- Analyze the stability of a dynamic system.

No.	Topic	Hours
1	Introduction to process dynamics and control- Laplace transform - transform of simple functions - derivatives and integral final value theorem - initial value theorem – transition of transforms and functions – examples - inversion by partial fraction	6
2	Forcing function-linear open loop systems - first order systems –linearization- mercury thermometer- liquid level and mixing processes – reactor-heating tank	9
3	Time delay response	3
4	First order systems in series - interacting and non-interacting types	6
5	Second order systems - manometer - impulse and step response of under damped, critically damped and over damped system	6
6	Closed loop system - servo and regulator problems - block diagram development - block diagram reduction	6
7	Controllers - types, basic principles and transfer functions - pneumatic & electronic controllers - PID, PI and PD	9

8	Final control element- control valve	6
9	Introduction to stability of linear systems - Routh criterion for stability	6
10	Introduction to frequency response - substitution rule - bode diagram for first order systems - first order systems in series - second order systems	9
11	Bode stability criterion, gain margin and phase margin - controller tuning- Ziegler-Nichols method - reaction curve method - comparison of closed loop responses for different controller settings	9
12	Application of control to chemical process	6
13	Control process by computer- Basic principles of advanced control systems: - supervisory control and data acquisition (SCADA) – distributed control system (DCS)- simulation by Simulink. (6)	9

Textbook:

1- Coughanewr D.P., Process System Analysis & Control, McGraw Hill

References:

1- Harriot P., Process Control, Tata McGraw Hill
2- Stephanopoulose G., Chemical Process Control, An Introduction to Theory & Practice, Prentice Hall
3- Ceaglske N.H., Automatic Process Control for Chemical Engineers
4- Eckman D.P., Principles of Industrial Process Control
5- Tsai T.H., Lane J.W. &Lom C.S., Modern Control Techniques for the Processing
6- Industries, Marwel Dekker

1-For Laboratory

Internal Continuous Assessment (Mximum Marks-50)

60%-Laboratory practical and record

30%-Tests

10%-Regularity in the class

End Semester Examination (Maximum Mark Mark-50)

70%-Procedure, conducting experiment, result, tabulation, and inference

20%-Viva voce

10%-Fair record

1-For Theory Subjects

Internal Continuous Assessment (Mximum Marks-40)

60%-Test (minimum 2)

30%-Assigments (minimum 2) such as homework, problem solving, group discussion, quiz,seminar, term-project, software exercises, etc.

10%-Regularity in the class

TU Examination Pattern (Mximum Marks-60)

PART A: Short answer questions (one/two sentences) 5 x 2 marks-10 marks

All questions are compulsory. There should be alt least one question from each module and not more than two questions from any module.

PART B: Anlytical/Problem solving questions 4 X 5 marks-20 marks

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descroptive/Analytical/Problem solving question3 3 x 10 marks- 30 marks

Two questions from each module with choice to answer one question.