Course Code	CP314
Course Title	Process Control Systems
No. of Credits	3
Pre-requisites	EM211
Compulsory/Optional	Compulsory

Aim(s): To provide essential knowledge and practice to understand and analyze process control engineering problems so as to design optimal process control systems

Intended Learning Outcomes:

On successful completion of the course, the students should be able to

ILO 1: Develop dynamic process models

ILO2: Design the process controller

ILO 3: Analyze the control performance

ILO 4: Design optimal process control systems

Topics	**Time Allocation/Hours**			
	L	**T**	**P**	**A**
• **Introduction to process control** Objectives and importance of process control in process engineering facilities; Concepts of feedback and feed-forward controls; Basics of design of the process control systems	01			
• **Modeling and simulation of processes** Mathematical modelling of dynamic behaviour of processes using material and energy balance equations; Derivation of the linearized transfer model using Taylor expansion; Laplace transforms reviewed; Derivation of the transfer function from the linear or linearized dynamic model among the input and the output variables; Dynamic behaviours of first, second and higher order processing systems; model development using step response; Simulation of selected dynamic systems using simulation software	08			06
• **Control actions and dynamics of control systems** Characteristics of on-off, proportional (P), integral (I) and derivative (D) controllers; adjusting the control parameters; relationship between the pole of the transfer function and the stability; basic feature, the steady-state characteristics and the stability of the feedback control system are explained; relationship between the sine wave input and the output (the frequency response); detecting the stability from the frequency response; features of various filters.	09			
• **PID control system design** Tuning methods of PID parameters; modification to the basic PID controller for improving the performance; tuning the control parameters and verifying the performance for selected processes	09			06
• **Advanced control systems** Feed-forward control; ratio control; cascade control; multi-loop control; interaction and decoupling of control loops; developing a controller for a multi-loop control for a multiple-input, multiple-output process such as a	06			06

two-input, two-output process.				
• **Piping and Instrumentation** Equipment used for real process control systems, P&ID diagrams	03			
Total equivalent hours	**36**			**09**

Recommended Texts:

- Stephanopoulos, G., Chemical Process Control – An Introduction to Theory and Practice, (1 Ed), PTR Prentice Hall, 2008.
- Seborg, D. E., Edgar, T. F., Mellichamp, D. A., Process Dynamics and Control, (2 Ed), Wiley John and Sons, 2003.
- Chemical Process Dynamics and Controls Book I, University of Michigan Chemical Engineering Process Dynamics and Controls Open Electronic Textbook. URL: (https://open.umich.edu/sites/default/files/downloads/chemical_process_dynamics_and_controls-book_1.pdf)
- Chemical Process Dynamics and Controls Book II, University of Michigan Chemical Engineering Process Dynamics and Controls Open Electronic Textbook. URL: (https://open.umich.edu/sites/default/files/downloads/chemical_process_dynamics_and_controls-book_2.pdf)

Assessment	**Percentage Mark**
In-course Tutorials/Assignments/Quizzes	40
End-semester	60