III CHE473 Instrumentation and Process Control

Course Outlines

- **Title:** Instrumentation and Process Control
- **Code Number:** CHE 473
- **Semester:** 7th
- **Credit hours:** 3
- **Pre-requisites course requirements/ skills:** CHE122, CHE231
- **Learning Outcomes:**

Upon successful completion of the course, the students will be able to:

1. Describe basic principles and working of measuring instruments used in process industries.
2. Explain the dynamic behaviour of processes in terms of transfer functions.
3. Analyse suitable controller and control scheme for a given industrial process.

- **Contents**

Unit I: Instrumentation for Process Control

1.1 Static and dynamic characteristics of instruments.
1.2 Types of measurements and instrument errors.
1.3 Working principle and application of process instruments for process variables
1.4 Control valve types and characteristics.

Unit II: Dynamics of Process Control

2.1 Modelling and analysis of process control
2.2 Transfer functions and their determination using input-output models and Laplace transformation.
2.3 Dynamic response of first and second order systems to various input functions.
2.4 Linearization of higher order systems.
2.5 Overall transfer function and closed loop response.

Unit III: Application of Process Control

3.1 Introduction and significance of Process Control.
3.2 Concept of feedback control.

3.3 Effect of proportional, integral, derivative, and composite actions on response of controlled processes.
3.4 Controller tuning.
3.5 Introduction to frequency response analysis; Routh-Hurwitz method, Bode and Nyquist plots.
3.6 Feed Forward Control
3.7 Multi-loop control: Cascade Control, Ratio Control, Selective Control, Split Range Control.
3.8 Control loops for common industrial process equipment

- **Teaching-learning Strategies**

The teaching and learning strategy has been designed on the understanding of concepts and the ability to critically analyze and apply the learned content through lectures, discussion, activities, case studies using computer, multi-media and writing board instructional aids.
Lectures: 3 hours per week

- **Assignments- Types and Number with calendar**

A minimum of two assignments to be submitted before the written exam of final Term

- **Assessment and Examinations**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written examination at the mid-point of the semester.
2.	Formative Assessment	25%	It includes: classroom participation, attendance and assignments.
3.	Final Assessment	40%	Written examination at the end of semester.

- **Textbooks and reference readings**

1. Coughanowr, D.R., LeBlanc, S.E. (2009), "Process Systems Analysis and Control" 3rd Edition. McGraw Hill.
2. Smith, C.A., Corripio, A.B. (2003), "Principles and Practice of Automatic Process Control" 3rd Edition, Wiley.
3. Seborg, D.E., Edgar,T.F., Mellichamp, D.A., Doyle,F.J.(2016) "Process Dynamics and Control" 4th Edition, Wiley & Sons.

4. Smith, C.L., (2009), “Practical Process Control: Tuning and Troubleshooting”, Wiley & Sons.
5. Liptack, B. (2012) “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis,” Vol-I, CRC.
6. King, M. (2010) “Process Control: A Practical Approach”, Wiley & Sons.
7. Marlin, T.E. (2000), “Process Control: Designing Processes and Control system for Dynamic Performance” 2nd Edition, McGraw Hill.