Course code	Course name	L-T-P-Credits	Year of Introduction
AE302	**PROCESS CONTROL**	**4-0-0-4**	**2016**

Prerequisite : Nil

Course objectives
- To introduce the principles of various control and instrumentation components and strategies applied in a process control system.
- To Basics of Principals of Sensors and Transducers, Control System Component and Process Loop Control

Syllabus

Process characteristics - Types of processes- Analysis of Control Loop- Analysis of Flow Control- Feedback Control- Multi Loop & Nonlinear Systems-Concept of Multivariable Control- Intelligent Controllers

Expected outcome
- At the end of the semester students will be able to understand and analyse the different behaviour of process control system performances.

Text Books
1. B.Wayne Bequette, *Process Control: Modeling, Design and Simulation,* PHI
2. Donald Eckman – *Automatic Process Control*, Wiley Eastern Limited
3. F.G.Shinskey, *Process control Systems* ,TMH

Reference Books
1. B.G.Liptak ,*Handbook of Instrumentation -Process control* ,Chilton
2. Considine, *Process Instrumentation and control Handbook* , 5th Ed., McGraw Hill
3. Krishna Kant, *Computer Based Industrial Control* ,PHI
4. Murrill ,*Applications concepts of Process control*, ISA
5. Murrill, *Fundamentals of Process Control* , ISA
6. Stephanopoulos George ,*Chemical Process Control*, PHI
7. T.J.Ross *Fuzzy Logic with Engineering Applications*, John Wiley & Sons, 2004
8. Thomas E Marlin - *Process Control- Designing processes and Control Systems for Dynamic performance,* McGraw-Hill International Editions

	Course Plan		
Module	**Contents**	**Hours**	**Semester Exam Marks**
I	Process characteristics: Incentives for process control, Process Variables types and selection criteria,, Process degree of freedom, The period of Oscillation and Damping, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics, Types of processes- Dead time, Single /multi capacity, self-Regulating /non self-regulating, Interacting /non interacting, Linear/non-linear, and Selection of control action for them. Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts	9	15%
II	Analysis of Control Loop: Steady state gain, Process gain, Valve gain, Process time constant, Variable time Constant, Transmitter gain, Linearizing an equal percentage valve, Variable pressure drop. Analysis of Flow Control, Pressure Control, Liquid level Control, Temperature control, SLPC-	8	15%

	features, faceplate, functions, MLPC- features, faceplate, functions, SLPC and MLPC comparison. Scaling: types of scaling, examples of scaling		
FIRST INTERNAL EXAMINATION			
III	Feedback Control: Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control. Factors in Controller Tuning, Determining Tuning Constants for Good Control Performance, Correlations for tuning Constants, Fine Tuning of the controller tuning Constants.	8	15%
IV	Multi Loop & Nonlinear Systems: Cascade control, Feed forward control, feedback-feed forward control, Ratio control, Selective Control , Split range control- Basic principles, Design Criteria , Performance, Controller Algorithm and Tuning, Implementation issues, Examples and any special features of the individual loop and industrial applications. Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance.	9	15%
SECOND INTERNAL EXAMINATION			
V	Multivariable Control: Concept of Multivariable Control: Interactions and its effects, Modelling and transfer functions, Influence of Interaction o the possibility of feedback control, important effects on Multivariable system behaviour Relative Gain Array, effect of Interaction on stability and tuning of Multi Loop Control system. Multi Loop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.	10	20%
VI	Intelligent Controllers: Step analysis method for finding first, second and multiple time constants and dead time. Model Based controllers: Internal Model control, Smith predictor, optimal controller, Model Predictive controller, Dynamic matrix controller (DMC). Self Tuning Controller. Fuzzy logic systems and Fuzzy controllers, Introduction, Basic Concepts of Fuzzy Logic, Fuzzy Sets, Fuzzy Relation, Fuzzy Graphs, and Fuzzy Arithmetic, Fuzzy If-Then Rules, Fuzzy Logic Applications, Neuro-Fuzzy Artificial Neural networks and ANN controller.	10	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100   Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)