COURSE TITLE   : PROCESS CONTROL
COURSE CODE   : 5212
COURSE CATEGORY : A
PERIODS/WEEK   : 5
PERIODS/SEMESTER: 65
CREDITS   : 5

TIME SCHEDULE

Module	Topics	Period
1	Concept of Process Control	13
2	Modes of control and controllers	15
3	Final Control Element	20
4	Communication In Process Control	17
TOTAL		**65**

COURSE OUTCOME

Module	G.O.	On completion of the study of this module the student will be able
1	1	To understand the concept of process control
	2	To understand process characteristics
	3	To understand control system parameters
	4	To comprehend the examples of process control systems
2	1	To understand the various control modes
	2	To understand the implementation of pneumatic controllers
	3	To understand the implementation of electronic controllers
3	1	To understand final control operation
	2	To comprehend the working of Control Valves
	3	To understand the working of Auxiliary units of Control Valves
4	1	To comprehend telemetry system
	2	To understand digital communication channels in process control

On completion of the study the student will be able

MODULE I   CONCEPT OF PROCESS CONTROL

1.1.1 To understand the concept of Process control
      1.1.1 To define Process, Process Control & Process Plant
      1.1.2 To describe Human aided control & Automatic control with suitable example
      1.1.3 To explain the block diagram of process control
      1.1.4 To define Error, set point, controlled variable, manipulated variable, and
          Measured variable
      1.1.5 To describe the elements of process control loop

1.2.0 To understand the Process characteristics
      1.2.1 To define Process equation
      1.2.2. To define Process Load
      1.2.3. To define Process Lag
      1.2.4. To explain Self Regulation with   example.

1.3.0 To understand Control System Parameters
      1.3.1 To define Error
      1.3.2 To define Variable Range
      1.3.3 To define Control Parameter Range
      1.3.4 To define control Lag
      1.3.5 To define Dead   Time
      1.3.6 To define Cycling.

1.4.0 To comprehend the process control loops
      1.4.1 To explain Temperature process control system and identify process parameters
      1.4.2 To Illustrate Pressure process control system and identify process parameters
      1.4.3 To describe Flow process control system and identify process parameters
      1.4.4 To explain Level process control system and identify process parameters

MODULE II   MODES OF CONTROL AND CONTROLLERS

2.1.0 To understand the various control modes
      2.1.1 To explain Discontinuous control modes- two position, neutral zone , multi position
          control   mode
      2.1.2 To describe proportional control mode
      2.1.3 To define proportional band and offset error
      2.1.4 To explain integral control mode
      2.1.5 To define reset rate
      2.1.6 To illustrate the derivative control mode
      2.1.7 To define derivative time
      2.1.8 To describe the composite control modes PI, PD and PID
      2.1.9 To compare P, PI, PD and PID Control modes

2.2.0 To understand the implementation of Pneumatic Controllers
      2.2.1 To describe flapper-nozzle system
      2.2.2 To explain the implementation of pneumatic error detector

2.2.3 To illustrate the implementation of pneumatic Proportional controller
2.2.4 To explain the implementation of pneumatic PI controller
2.2.5 To describe the implementation of pneumatic PD controller
2.2.6 To explain the implementation of pneumatic PID controller

2.3.0 To understand the implementation of Electronic Controllers
2.3.1 To explain the implementation of electronic error detector
2.3.2 To describe the implementation of electronic Proportional controller.
2.3.3 To explain the implementation of electronic PI controller
2.3.4 To illustrate the implementation of electronic PD controller
2.3.5 To explain the implementation of electronic PID controller.

MODULE III   FINAL CONTROL ELEMENTS

3.1.0 To understand final control element
3.1.1 To describe the block diagram of Final control operation
3.1.2 To explain working of pneumatic, electric and hydraulic actuators, with diagram

3.2.0   To comprehend the working of Control Valves
3.1.1 To explain air to open and air to close control valves
3.1.2 To describe the different valve plugs –
     a) Single seated & Double seated valve.
     b) Butterfly valves, Ball valve, Globe valve & Solenoid valve
3.1.3 To describe the flow characteristics of control valves (Linear, Equal
    Percentage & Quick Opening)
3.1.4 To define control valve coefficient Cv, Rangeability and Turn down
3.1.5 To illustrate inherent flow characteristics
3.1.6 To describe control valve sizing
3.1.7 To explain cavitation and flashing.

3.3.0 To understand the working of auxiliary units of Control Valves
3.3.1 To describe the working principle and application of valve positioner, motion
    transmitter, booster relay, limit switch, air pressure regulator & I/P converter

MODULE IV   COMMUNICATION IN PROCESS CONTROL

4. 1.0 To comprehend telemetry system
4.1.1 To define the term Telemetry
4.1.2 To explain the General Telemetry system with block Diagram
4.1.3 To illustrate Voltage Telemetry System
4.1.4 To explain Current Telemetry System
4.1.5 To describe motion balance and Force balance current telemetry systems
4.1.6 To explain Position Telemetry System

4.2.0   To understand Digital Communication channels in Process Control
4.2.1 To describe field bus
4.2.2 To explain the advantages of field bus

4.2.3 To describe Profibus
4.2.4 To illustrate the Functional elements in foundation Field bus
4.2.5 To describe HART (Highway –Addressable Remote Transducer)
4.2.6 To illustrate the benefits of HART field –communication protocol
4.2.7 To explain the working of HART
4.2.8 To describe the block diagram of HART digital communication System.
4.2.9 To illustrate the basic HART Specification- HART Physical Layer-HART Data Link
       Layer- Network Layer-The Transport Layer-Application Layer

CONTENT DETAILS

MODULE I

Process- Process Control & Process Plant -Human aided control & Automatic control- Block diagram of process control - Error, set point, controlled variable, manipulated variable, and measured variable - Elements of process control loop - Process characteristics - Process equation, Process Load, process Lag & Self Regulation with Control System Parameters - Error, Variable Range, Control Parameter Range, Control Lag - Dead   Time, Cycling - Process Parameters - Temperature process control , Pressure Process control system - Flow process control system , Level process control system

MODULE II

Discontinuous control modes - two position - neutral zone -- multi position control mode-Continuous Control Modes - proportional control mode -proportional band and offset error - integral control mode – reset rate -derivative control mode - derivative time- composite control modes- PI, PD and PID control modes - Pneumatic Controllers –Error detector-Proportional controller   - PI controller - PD controller - PID controller -Electronic Controllers- -Error detector-Proportional controller   - PI controller - PD controller - PID controller

MODULE III

Final control element -block diagram of final control operation - working of pneumatic, electric and hydraulic actuators - Control Valves -air to open and air to close control valves - Different valve plugs – Single seated & Double seated valve- Butterfly valves, Ball valve, Globe valve & Solenoid valve - Inherent flow characteristics- Control Valve coefficient Cv, Rangeability, Turn down, inherent flow characteristic, -Control Valve Sizing- Cavitation & flashing-Auxiliary units for control valve - valve positioner, motion transmitter, limit switch, booster relay, air pressure regulator - I/P converter

MODULE IV

Telemetry system- General Telemetry system block Diagram- Voltage Telemetry System- Current Telemetry System - motion balance and Force balance telemetry systems - Position Telemetry System

Digital communication channels - Field bus- advantages of field bus- Profibus -Functional elements in foundation Field bus. Highway –Addressable Remote Transducer-Benefits of HART field –communication protocol. Working of HART - Block diagram of HART digital communication System - HART Specification

REFERENCES

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3 A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation
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