

Semester-I Paper-1
PROCESS INSTRUMENTATION

Teaching scheme

Lectures: 4 Hrs / Week
Practical: 2 Hrs/ week

Examination scheme

Theory: 100 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1.

(10 Hrs, 20 Marks)

Process characteristics: Types of Processes (Dead time, single and multicapacity, Self and non-self regulating, interacting and non-interacting, linear and non-linear processes), Process gains, process reaction curve, process time constant and constant step analysis method for finding time constant, Dead time. Dynamic elements in control loops. PID control of processes. Process simulators.

Unit 2.

(10 Hrs, 20 Marks)

Analysis and properties of some common loops: Flow, pressure level, temperature, composition, pH etc. Linear and non linear controllers, review of PID with limitations (offset, saturation in D, & reset windup) rate before reset, PID variations, and tuning, Digital controller (position and velocity algorithms, effect of sampling time) hardware structures, features and specification, Single loop and multiloop controllers and the application programs, Non-linear controller-two state, three state, proportional time, dual mode, optimal switching.

Unit 3.

(10 Hrs, 20 Marks)

Multi-loop and multivariable process control systems: Feed back, Feed forward control, cascade control, ratio control, auto selective control, split range control, Predictive control systems and Adaptive control systems.

Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.

Unit 4.

(10 Hrs, 20 Marks)

Boiler instrumentation and Optimization, boiler equipment safety interlocks, Boiler efficiency and dynamics, boiler controls, combustion control, air to fuel ratio control, 3 element drum level control, steam pressure control, steam temperature control, burner management and control boiler optimization, Furnace control of heat exchangers, steam and fired heaters control, reboilers, vaporization and condensers.

Unit 5.

(10 Hrs, 20 Marks)

Instrumentation scheme for Pumps and compressor controls, multieffect evaporators, dryer, chemical reactors, cooling tower, rolling mill, extruder, crystallizer, chiller and ORP control.

References:

1. Process control systems, "F. G. Shinskey", (TMH)
2. Process control, "B.G. Liptak" (Chilton)
3. Computer Based industrial control, "Krishna kant" (PHI)
4. Feedback controllers tuning, applications and designing, "F. G. Shinskey" (TMH)

5. Tuning of PID controllers (ISA)
6. Chemical Process Control, "G.Stephanopoulos", (PHI).
7. Process instrumentation and control handbook, "considine", (MGH).
8. Process control instrumentation, "C. D. Johnson", (PHI)
9. Continuous process control (ISA)
10. Smart sensors ISA
11. Statistical process Control ISA
12. Multivariable process control ISA

List of Experiments:

1. Find the time constant of single capacity / Multi-capacity process by graphical methods.
2. Study of interacting and non-interacting process.
3. Study and analysis of flow / level /pressure control loop.
4. Design of temp. / Level / flow/ pressure transducers.
5. Study and configuration of smart transmitter.
6. Study of signal loop programmable controller.
7. Implementation of cascade controller.
8. Design and implementation ratio controller.