

COURSE TITLE : PROCESS CONTROL AND INSTRUMENTATION
COURSE CODE : 4100
COURSE CATEGORY : A
PERIODS/WEEK : 4
PERIODS/SEMESTER : 72
CREDITS : 4

TIME SCHEDULE

MODULE	CONTENTS	PERIODS
I	General Characteristics of Instruments, Temperature scales and Temperature & Pressure measuring Instruments	18
II	Liquid level and flow measuring instruments	18
III	Transducers and types of control actions Application of pneumatic and electrical devices	18
IV	General process in Polymer products manufacture and Control of Temperature, Pressure, Hydraulic systems, Hydraulic pumps and pumping devices	18
	TOTAL	72

OBJECTIVES

MODULE - I

2.1.0 Understand the general characteristics of instruments- various instruments used for measuring temperature and pressure

- 1.1.1 Explain the general characteristics of instruments Viz, static and dynamic
- 1.1.2 Discuss accuracy, sensitivity and repeatability
- 1.1.3 State fidelity, responsively, reproductively
- 1.1.4 State the various temperature scales
- 1.1.5 Define Celsius scale, Fahrenheit scale, Kelvin scale and Rankine scale
- 1.1.6 Generalize the various temperature measuring devices
- 1.1.7 Explain the principle, construction and working of mercury in glass thermometers, lab and industrial types
- 1.1.8 Explain the principles, construction and working of a bimetallic thermometer
- 1.1.9 Explain the principle construction, working range and errors of a pressure spring thermometer
- 1.1.10 Explain the principle and working of resistance thermometer and the circuit (wheat stone bridge)
- 1.1.11 Explain the principle of thermo couples – Seebeck effect, thermo electric laws
- 1.1.12 Explain the working of a thermo couple in a potentiometer circuit
- 1.1.13 Explain thermo couple metal combination and their ranges
- 1.1.14 Explain pyrometers – optical pyrometer, radiation pyrometer, principle and working
- 1.1.15 Describe the various pressure scales, Viz gauge pressure, absolute pressure and vacuum scales

- 1.1.16 Define liquid pressure head
- 1.1.17 Explain the construction and features of a U-tube manometer
- 1.1.18 Explain the construction and features of a micro manometer
- 1.1.19 Illustrate the working of a C type Burden tube
- 1.1.20 Explain the working of a spiral and helical manometer
- 1.1.21 Describe the construction and working of diaphragm gauge
- 1.1.23 Explain the construction and working of bellows

MODULE - II

2.1.0 Understand the principles involved in the measurement of liquid level and flow

- 2.1.1 Explain the various instruments used in the measurement of liquid flow
- 2.1.2 Distinguish direct and indirect mean of liquid level measurement
- 2.1.3 Explain sight glass, bob and tape type of level measuring devices
- 2.1.4 Explain float actuated level measurement devices
- 2.1.5 Explain cable and pulley type of level measuring devices
- 2.1.6 Explain the working of a magnetic follower doughnut and float actuated level measuring device
- 2.1.7 Explain the working of bubbler type of level measuring device
- 2.1.8 Differentiate between total flow and rate of flow meters
- 2.1.9 State Bernoulli's theorem
- 2.1.10 Describe the principle and working of a venturi tube
- 2.1.11 Describe the principle and working of an orifice meter
- 2.1.12 Explain variable area meter with reference to the principle and working of a rotameter
- 2.1.13 State the principle and working of turbine meters (Pulse generating)
- 2.1.14 Explain the working of a lobed type of positive displacement meter
- 2.1.15 Explain mass flow meters, using radioactive rays.

MODULE-III

3.1.0 Understand the characteristics of various transducers and controllers

- 3.1.1 Explain transducers
- 3.1.2 Describe the application of transducers for pressure measurement
- 3.1.3 Describe the use of strain gauge in pressure measurement
- 3.1.4 Explain the use of L.V.D.T. and its construction
- 3.1.5 Describe the principle and application of piezo electric transducers
- 3.1.6 Describe the working of resistance type of transducers in conjunction with bellows and other pressure measuring devices
- 3.1.7 Describe the application of various pneumatic and electrical devices for the process control
- 3.1.8 Generalize the various process responses to step input
- 3.1.9 Discuss the terms dead time, lag and capacitance
- 3.1.10 Differentiate between open loop and closed loop controls
- 3.1.11 Generalize the various control actions
- 3.1.12 State the working principle, applications and limitations of an ON- OFF control action
- 3.1.13 Explain the working, application and limitation of proportional control action
- 3.1.14 Explain integral control action, its advantages and limitations
- 3.1.15 Explain derivative action its advantages and limitations
- 3.1.16 Describe P.I.D controllers and their advantages
- 3.1.17 Generalize the principles of pneumatic controls

- 3.1.18 Explain pneumatic controls with two examples
- 3.1.19 Explain the uses of electronic controls in process control with two examples

MODULE-IV

4.1.0 Understand the various process in the manufacturing polymer products, control devices and unit operations

- 4.1.1 Describe the methods of measurement and control, variable like temps, pressure etc in polymer processing
- 4.1.2 Explain the various process used in rubber and plastics with respect to temperature and pressure
- 4.1.3 Describe Hydraulic systems with principles of Hydraulic press, hydraulic lift, hydraulic crane
- 4.1.4 State the principles of hydraulic pumps
- 4.1.5 Define the principles of pumping devices

COURSE CONTENT

MODULE - I

General characteristics of Instruments-static and dynamic characteristics-Measuring instruments

Temperature scales like Celsius, Fahrenheit, Kelvin and Rankine

Temperature measuring devices – mercury in glass thermometer, Bimetallic thermometer, working of pressure spring thermometer and the errors in the instrument. Resistance thermometer and wheat stone bridge circuit .Seebeck effect, thermo electric laws and the working of thermo couple in potentiometer circuit. Thermo couple, metal combinations and their ranges, Pyrometer, working of optical and radiation pyrometer-Pressure scales - gauge pressure, absolute pressure and vacuum scales-Liquid pressure head- construction and features of ‘U’ tube manometer, well type manometer and micro manometer -Working of C type, spiral and helical manometer-Construction and working of bellows and diaphragm gauges

MODULE – II

Direct and indirect mean of level measurement Viz sight glass, bob and tape, float actuated, cable and pulley type, magnetic float actuated and bubbler type. Rate of flow and total flow meters. Bernoulli’s theorem, derivation of Bernoulli’s theorem, application of Bernoulli’s equation. Working of venturi meter, and orifice meter. - Variable area flow meters Rotometer. Pulse generating turbine meter, lobed type of flow meter, magnetic flow meter, radioactive flow meters.

MODULE - III

Transducers -Applications of following transducers in pressure measurement- LVDT strain gauges, resistance type transducers, piezoelectric transducers.-Step function response curve of various processes with respect to terms like time lags, dead time, capacitances. Open loop and closed loop control action. Control actions –ON- OFF, proportional, integral, derivative and PID with respect to advantage and limitations of each control action-Principle and application of pneumatic controls, electronic controls with any two examples

MODULE-IV

Compression, transfer and injection moulding processes with respect to control of temperature and pressure. Extrusion, calendaring, internal mixing with respect to control of temperature and pressure. Control systems used in plastic and rubber industry. Types of pumps, centrifugal pump, types of casings, piping systems, reciprocating pump, comparison of pumps, and air compressors.

Hydraulic systems- hydraulic press, derivation of efficiency, hydraulic crane, hydraulic lift, suspended hydraulic lift, hydraulic coupling. Pumping devices, working of hydraulic ram, jet pump, air lift pump, rotary pumps, external gear pump, internal gear pump, Lobe pump and vane pump.

REFERENCE BOOKS

- | | | |
|---|---|-----------------|
| 1. Mechanical measurement and Instruments | – | A.K. Sawhney |
| 2. Instrumentation | – | Donald.P.Echman |
| 3. Instrumentation | – | Kirk |
| 4. A Text book of Hydraulics | – | R.S. Khurmi |