Process Measurement, Instrumentation & Process Control ; Principles & Best Practices

Date	Venues	($)Fees	Book your seat
09 Mar -13 Mar 2025	Kuala Lumpur	3300	Register Now

Introduction

In an industrial situation where it is required to measure and control some aspect of a process, it is often the application of the knowledge and the ingenuity of the Engineer or Technician which is relied upon to solve the measurement and control problem. Therefore a fundamental understanding of the principle of operation of a range of sensors/transducers and instrumentation techniques applicable in an industrial situation combined with an understanding and knowledge of Process control techniques and tuning methods equips the Engineer or Technician with the necessary skills and makes them invaluable in their workplace.

Delegates will investigate the operating principles and concepts of instrumentation and measurement systems and will acquire the knowledge relating to the characteristics and properties of the variables being measured.

Moreover, the delegate will gain an understanding of the Process Control Systems and methods used in a modern industrial system.

This is a hands-on, practical course and where applicable, theoretical studies will be supplemented with practical activities where the delegate will have the opportunity to design, develop, build, test and evaluate their own instrumentation systems within the seminar room.

Some of the main topics covered include:

- Introduction to the principles and fundamentals of Process Measurement and Instrumentation systems and Process variables. Symbols and units used and sample calculations
- Principles of operation of Sensors and Transducers used for:
    - Temperature Measurement
    - Strain measurement
    - Pressure measurement
    - Flow measurement
    - Level measurement
- Ultrasonic techniques for non-invasive process measurement
- Principles of Process Control and study of the main Control strategies used, leading to an explanation of the 3-term PID controller
- Explanation of a method used to ‘tune’ a 3-term PID controller
- Practical activities to design, build, calibrate and signal condition a typical sensor application

Objectives

The main objectives of this seminar are:

- To give an understanding of the principles of operation of a range of sensors and transducers
- By using a hands-on approach, enable the delegate to investigate the operation of an instrumentation system

through designing, building and testing typical sensor combined with appropriate signal conditioning circuits
- To allow the delegate to become familiar and confident with a range of measurement techniques
- To understand the concepts of Process Control and acquire the knowledge relating to the characteristics and properties of a process variable being measured
- To become familiar and knowledgeable with PID control and develop the ability to ‘tune’ a process control system using PID control
- To have the confidence and knowledge to apply the above techniques and principles to solve an unfamiliar and bespoke measurement situation in the workplace

Training Methodology

The seminar is delivered via a series of mixed activities which will at times involve delegate participation. Theoretical content is delivered by informal lecture and discussion and supplemented where appropriate with tutorial sessions using worked examples. An opportunity is given for delegates to perform their own calculations based on sample systems.

An important part of the program is the hands-on aspect. Approximately a quarter of the total time will be devoted to practical activities. Delegates will acquire the skills to design their own instrumentation system from a given sensor(s) and specification and also, using relevant software, acquire the skills to ‘tune’ a process control system.

Organizational Impact

By attending this seminar, the delegate will return to their company more confident in the knowledge and use of sensors and instrumentation systems generally. More specifically, they will:

- Be equipped with new skills and knowledge which must impact positively within the company structure
- Consequently be able to leverage their skills to potentially cause an increase within the plant or process in term of overall productivity and efficiency through an appreciation of the operating principles of a range of sensors and transducers
- Be better equipped to advise on new system installations in terms of sensor choice and specification and circuit design
- Potentially through their newly acquired knowledge be able to advise on in-house use of suitable sensor technologies used in plant process and instrumentation systems thereby negating or at least reducing the dependency on external agencies and vendors
- Therefore potentially contribute towards and result in plant and process cost reductions leading to financial savings for the company

Personal Impact

The delegate will benefit personally from attendance of this seminar and will enhance their own knowledge base and level of confidence in the area of Sensor Technologies and Process Control Engineering. Specifically, the delegate will be able to:

- Understand the principle of operation of a range of sensors and transducers used in the measurement of flow, temperature, pressure, strain and level
- Review the construction and operation of the most important sensors and transducers and their application in process measurement systems
- Evaluate and select the most appropriate sensor technology for a given instrumentation system
- Design, build and test using a given specification and sensor, their own instrumentation system within the seminar room
- Identity components and features of a Process control system
- Calibrate and signal condition the above system and take measurements from the system
- Understand the limitations of Open loop systems and be aware of the inherent problems associated with Closed loop negative feedback systems
- Optimise control by tuning a system using relevant software

Who Should Attend?

This seminar is suitable for and is designed to attract and be of benefit to a range of people who work in the instrumentation and process plant area. Typically but not exclusively this seminar will be of benefit to:

- Electronic Engineers and Technicians
- Chemical Engineers and Technicians
- Electrical Engineers and Technicians
- Electronic Design Engineers
- Instrumentation Technicians
- Electricians
- Installation and Maintenance Technicians
- Instrument and Process Control Technicians
- Instrument Fitters
- Maintenance Engineers
- Mechanical Engineers and Technicians
- Operations Engineers
- Process Technicians
- Production Professionals
- System Integrators
- Other professions (Engineers, Technicians) involved in the Process Industry who require an appreciation and understanding of the techniques used in Process Measurement and Control

SEMINAR OUTLINE

DAY 1

Introduction to Sensors, Transducers and Instrumentation Systems

- Course schedule and layout
- Introduction to Sensors, Transducers and Instrumentation Systems
- Examples
- Terms and definitions associated with Instrumentation systems, including;
    - Maximum error
    - Hysteresis
    - Repeatability
    - Sensitivity
    - Resolution
    - Span
    - Response time
- Examples
    - Process Variables
    - Mass flow
    - Volumetric flow rate
    - Pressure
    - Viscosity
    - Turbidity

DAY 2

Strain, Pressure and Flow Measurement *(also begin practical activities)*

- Principle of Strain Measurement – tension, compression, stress, strain, Youngs modulus
- Principle of operation, typical uses and installation considerations
- Gauge types – principle of operation and configurations
- Examples
- Principles of Pressure measurement
- Devices; principle of operation, typical uses and installation considerations of:

    - Diaphragms
    - Bellows
    - Capacitive devices
    - Fibre Optic pressure measurement techniques
- Principles of flow measurement
- Reynolds number
- Devices; principle of operation, typical uses and installation considerations of Invasive types:
    - Coriolis Flowmeter
    - Differential Pressure type flowmeters
        - Orifice plate
        - Venturi tube
        - Flow nozzle
        - Dall flow tube
    - Devices; principle of operation, application and installation considerations of non-invasive types
    - Electromagnetic flowmeters
- Practical activity 1 – Design and build a liquid level process measurement system

DAY 3

Temperature, Level and Non-Invasive Ultrasonic Measurement Techniques

- Temperature scales
- Devices; principle of operation, typical uses and installation considerations of:
    - Resistance temperature detectors (RTD’s)
    - Thermistors
    - Thermocouples
    - Radiation Pyrometers
- Examples
- Principle of single point and continuous level measurement techniques
- Direct and indirect level measurement techniques
- Devices; principle of operation, typical uses and installation considerations of:
    - Ultrasonic techniques
    - Capacitive techniques
    - Pressure techniques
- Principles and applications of Ultrasonic techniques for non-invasive measurement
- Doppler shift and transit techniques
- Principle of operation, typical uses and installation considerations of Non-invasive flow measurement
- Ultrasonic flowmeters
- Practical activity 2 – Calibrate the liquid level process measurement system

DAY 4

Introduction to Process Control Engineering

- Control Strategies
- Block diagram representation
- Control components
- Servomechanisms and Regulators
- Open and closed loop systems
- Transfer Functions
- Negative Feedback (NFB)
    - 1st and 2nd order systems
- Examples – Transfer functions and Closed Loop systems
- ON/OFF control
    - Two step control action
- Proportional control
- Proportional band vs. proportional gain
- Proportional offset
- Reset

- Integral action
- Integral windup
- Derivative action
- PID control
- Practical activity 3 – Signal condition the output from the Liquid measurement system and (if time allows) design and build a Strain gauge measurement system

DAY 5

Tuning PID Controllers

- Empirical methods of setting Controllers
- Open loop reaction curve method (Ziegler-Nichols)
- Default and typical settings
- Closed loop continuous cycling method (Ziegler-Nichols)
- Fine tuning
- Practical activity 4 – tuning a Control system using the Ziegler-Nichols methods

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