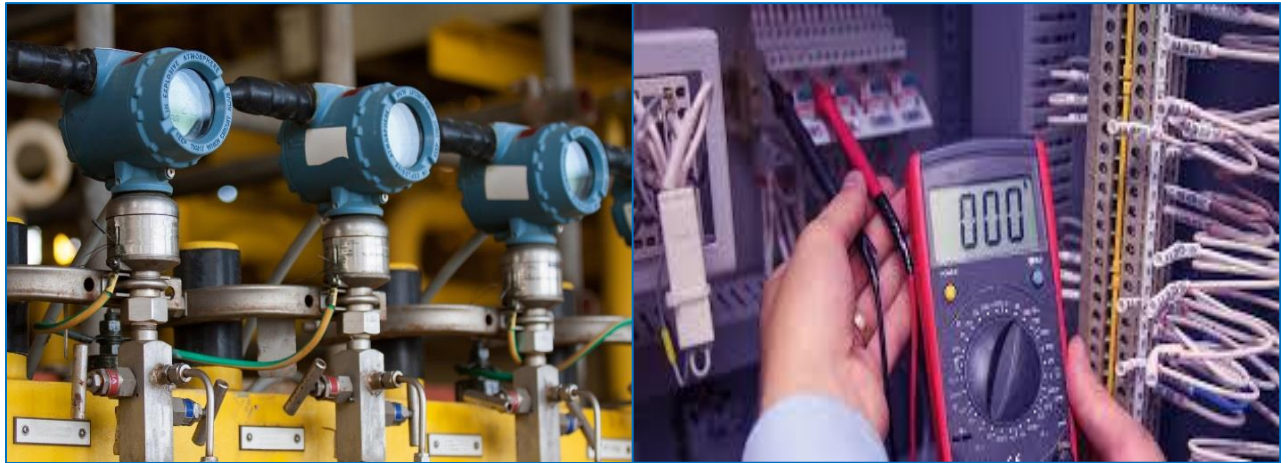




IE062: Process Measurement, Instrumentation & Process Control: *Principles & Best Practices*

Training Description:

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.

Participants on this course 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 participant will have the opportunity to design, develop, build, test and evaluate their own instrumentation systems within the course room.

The course will highlight:

- 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, and 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

Training Objectives:

By the end of the training, participants will be able to:

- ✓ To give an understanding of the principles of operation of a range of sensors and transducers
- ✓ Investigate the operation of an instrumentation system through designing, building and testing typical sensor combined with appropriate signal conditioning circuits through hands-on approach
- ✓ Familiarise and be confident with a range of measurement techniques
- ✓ Understand the concepts of Process Control and acquire the knowledge relating to the characteristics and properties of a process variable being measured
- ✓ Familiarise and be 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

Personal Impact:

- ✓ 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
- ✓ Identify 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

Organisational Impact:

- ✓ 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

Training Designed for:

This course is intended for a range of people who work in the instrumentation and process plant area. Typically, but not exclusively this course 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, and other professions (Engineers, Technicians) involved in the process industry who require an appreciation and understanding of the techniques used in process measurement and control.

Training Program:

DAY ONE:

- ❖ Pre-Test
- ❖ Introduction to Sensors, Transducers and Instrumentation Systems

- Introduction to sensors, transducers and instrumentation systems
- Terms and definitions associated with Instrumentation systems, including
 - Maximum error, Hysteresis, Repeatability, Sensitivity, Resolution, Span, Response time
- Process variables
 - Mass flow, Volumetric flow rate, Pressure, Viscosity, Turbidity

DAY TWO:

❖ Introduction to Practical and Operator Considerations

❖ Installation

- Mechanical
- Electrical
- Communications
- HMI

❖ Maintenance

- Mechanical
- Electrical
- Communications
- HMI

❖ Troubleshooting

- Mechanical
- Electrical
- Communications
- HMI

❖ Strain, Pressure and Flow Measurement

- Principle of strain measurement – Tension, compression, stress, strain, Young's modulus
- Principle of operation, typical uses and installation considerations
- Gauge types – Principle of operation and configurations
- Principles of Pressure measurement
- Devices: Principle of operation, typical uses and installation considerations of
 - Diaphragms, Bellows, Capacitive devices
- 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
 - Devices: Principle of operation, application and installation considerations of non-invasive types
- Practical activity 1 – Installation, maintenance, and troubleshooting of a typical flowmeter

DAY THREE:

❖ 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
- Examples
- Devices: Principle of operation, typical uses and installation considerations of
 - Ultrasonic techniques, Pressure techniques
- Doppler shift and transit techniques
- Ultrasonic flowmeters
- **Practical activity 2 – Installation, maintenance, and troubleshooting of a typical temperature sensor and transmitter**

DAY FOUR:

❖ 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
- Derivative action
- PID control
- **Practical activity 3 – Detailed analysis of several control loops for a 3-phase separator**

DAY FIVE:

❖ 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 – Complete instrumentation and control systems for a 3-phase separator**

❖ Course Conclusion

❖ Post-Test and Evaluation

Training Requirements:

“Hands-on practical sessions, equipment and software will be applied during the course if required and as per the client’s request.”

This training course is available upon request in English or Arabic, virtual online live or face to face public/inhouse. Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant’s manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

For training registrations or in-house enquiries, please contact:

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Training & Career Development Department