COURSE OVERVIEW IE1118
Design Criteria in Instrumentation Engineering

Course Title
Design Criteria in Instrumentation Engineering

Course Date/Venue
September 21-25, 2025/Musandam Meeting Room, Royal Tulip Muscat, Muscat, Oman

Course Reference
IE1118

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

This course is designed to provide participants with a detailed and up-to-date overview of the Design Criteria in Instrumentation Engineering. It covers the instrumentation engineering and its role in industrial processes; the basic measurement principles and design considerations for process sensors; the control system architectures, instrumentation and control loop design; the documentation and project deliverables and temperature measurement design; and the pressure and differential pressure instruments.

Further, the course will also discuss the level measurement techniques and flow measurement devices, analytical instrument design, criteria and instrument specification sheets; the field instrument installation criteria, cable selection and routing design; the junction boxes and marshaling panels, intrinsically safe and explosion proof design, earthing and grounding design and instrument air system design; and the control valve design criteria and instrument-to-control system integration.

During this interactive course, participants will learn the safety instrumented systems (SIS) design covering SIL levels, risk analysis (LOPA), redundancy, voting logic, safety relays, PLCs, test intervals and proof testing; the communication protocols and networking, commissioning and calibration design aspects and design reviews and quality control; the smart instrumentation and digital technologies and designing for maintainability and reliability; and the instrumentation design for harsh environments including energy efficiency and sustainability in design.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an in-depth knowledge on design criteria in instrumentation engineering
- Discuss the instrumentation engineering and its role in industrial processes
- Explain basic measurement principles and design considerations for process sensors
- Illustrate control system architectures, instrumentation and control loop design and documentation and project deliverables
- Carryout temperature measurement design and recognize pressure and differential pressure instruments
- Apply level measurement techniques and flow measurement devices, analytical instrument design, criteria and instrument specification sheets
- Identify field instrument installation criteria, and carryout cable selection and routing design
- Recognize junction boxes and marshaling panels, intrinsically safe and explosion proof design, earthing and grounding design and instrument air system design
- Identify control valve design criteria and apply instrument-to-control system integration
- Illustrate safety instrumented systems (SIS) design covering SIL levels, risk analysis (LOPA), redundancy, voting logic, safety relays, PLCs, test intervals and proof testing
- Apply communication protocols and networking, commissioning and calibration design aspects and design reviews and quality control
- Recognize smart instrumentation and digital technologies and designing for maintainability and reliability
- Describe instrumentation design for harsh environments including energy efficiency and sustainability in design

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides a basic overview of all significant aspects and considerations of design criteria in instrumentation engineering for instrumentation engineers, electrical and control engineers, project engineers, project managers, process engineers, supervisors, technicians and other technical staff.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Haward's certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)
This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Barry Pretorius is a **Senior Instrumentation Engineer** with almost **30** years of extensive experience within the **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise widely covers in the areas of Distributed Control System (**DCS**), **DCS** Operations & Techniques, **Plant Control** and Protection Systems, **Process Control & Instrumentation**, **Cascade Control Loops**, **Split-Range Control Loops**, **Capacity Control** & Other Advanced Control Schemes, **Safety Instrumented Systems**, **Plant Automation** Operations & Maintenance, Programmable Logic Controller (**PLC**), **Siemens PLC** Simatic S7-400/S7-300/S7-200, **PLC & SCADA** for Automation & Process Control, **Artificial Intelligence**, **Allen Bradley PLC** Programing and Hardware Trouble Shooting, Schneider **SCADA System**, **Wonder Ware**, **Emerson**, **Honeywell**, **Honeywell** Safety Manager PLC, **Yokogawa**, Advanced **DCS Yokogawa**, **Endress & Hauser**, Field Commissioning and Start up Testing Pre Operations, System Factory Acceptance Test (**FAT**), FactoryLink ECS, Modicon 484, Rockwell Automation, System Site Acceptance Test (**SAT**), **SCADA HMI & PLC** Control Logic, **Cyber Security** Practitioner, **Cyber Security** of Industrial Control System, **IT Cyber Security** Best Practices, **Cybersecurity** Fundamentals, **Ethical Hacking & Penetration Testing**, **Cybersecurity** Risk Management, **Cybersecurity** Threat Intelligence, **OT Whitelisting** for Better Industrial Control System Defense, **NESA** Standard and Compliance Workshop, **OT**, **Cyber Attacks** Awareness - Malware/Ransom Ware / Virus /Trojan/ Philsing, **Information Security Manager**, **Security System** Installation and Maintenance, Implementation, Systems Testing, Commissioning and Startup, **Foxboro DCS & Triconics**, **SIS** Systems, Advanced **DC Drives**, Motion Control, **Hydraulics**, **Pneumatics and Control Systems** Engineering, **Electrical & Automation Control Systems**, **HV/MV Switchgear**, **LV & MV** Switchgears & Circuit Breakers, **High Voltage Electrical Safety**, **LV & HV Electrical System**, **HV Equipment** Inspection & Maintenance, **LV Distribution Switchgear & Equipment**, **Electrical Safety**, **Electrical** Maintenance, **Transformers**, **Medium & High Voltage Equipment**, **Circuit Breakers**, **Cable & Overhead Line** Troubleshooting & Maintenance, **Electrical Drawing & Schematics**, **Voltage Distribution**, **Power Distribution**, **Filters**, **Automation System**, **Electrical Variable Speed Drives**, **Power** Systems, **Power Generation**, **Diesel Generators**, **Power Stations**, Uninterruptible Power Systems (**UPS**), **Battery Chargers**, **AC & DC Transmission**, **CCTV** Installation, **Data & Fire Alarm** System, **Evacuation** Systems and **Electrical Motors & Variable Speed Drives**, & Control of Electrical and Electronic devices.

During Mr. Pretorius's career life, he has gained his practical experience through several significant positions and dedication as the **Senior Technical Analyst, Team Leader, Pre-operations Startup Engineer, Automation System's Software Manager, Automation System's Senior Project Engineer, PLC Specialist, Site Manager, Senior Project & Commissioning Engineer, Technical Director, Project Engineer, Radio Technician**, **A T E Technician** and **Senior Instructor/Trainer** from various companies like the ADNOC Sour Gas, Ras Al Khair Aluminum Smelter, Johnson Matthey Pty. Ltd, Craigcor Engineering, Unitronics South Africa Pty (Ltd), Bridgestone/Firestone South Africa Pty (Ltd) and South African Defense Force.

Mr. Pretorius's has a Higher Diploma in **Electrical Engineering Heavy Current**. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1: ***Sunday, 21st of September 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830– 0930	***Introduction to Instrumentation Engineering*** *Role in Industrial Processes • Instrumentation Lifecycle Phases • Key Standards & Codes (ISA, IEC, API) • Interface with Control Systems & Safety*
0930 – 0945	*Break*
0945 – 1030	***Basic Measurement Principles*** *Physical Properties (Temperature, Pressure, Flow, Level) • Sensor versus Transmitter Concepts • Accuracy, Precision, Resolution • Signal Conditioning Basics*
1030 – 1100	***Design Considerations for Process Sensors*** *Sensor Selection Criteria • Process Compatibility (Chemical, Thermal, Pressure) • Environmental Factors • Installation Constraints*
1100– 1230	***Control System Architectures*** *Centralized versus Distributed Systems • DCS & PLC Integration • Redundancy & Reliability • Scalability Considerations*
1230 – 1245	*Break*
1245 – 1315	***Instrumentation & Control Loop Design*** *Open versus Closed Loops • P&ID Interpretation • Loop Diagrams & Functional Descriptions • Instrument Loop Checks & Verification*

1315– 1330	***Documentation & Project Deliverables*** *Instrument Index Preparation • Data Sheets & Specifications • Loop Drawings & Wiring Diagrams • Cable Schedules & Terminal Plans*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2: Monday, 22nd of September 2025

0730 – 0830	***Temperature Measurement Design*** *RTDs, Thermocouples, Thermistors • Insertion Length, PROTECTION Wells • Accuracy Class & Range • Environmental & Installation Factors*
0830– 0930	***Pressure & Differential Pressure Instruments*** *Types (Gauge, Absolute, DP) • Impulse Line Design • Manifold & Tapping Point Considerations • Installation Guidelines*
0930 – 0945	*Break*
0945 – 1130	***Level Measurement Techniques*** *Displacer, Radar, Ultrasonic, DP-Based • Interface Measurement Challenges • Vessel Connection Points • Calibration & Rangeability*
1130 – 1230	***Flow Measurement Devices*** *Differential Pressure, Magnetic, Coriolis, Ultrasonic • Reynolds Number & Straight Run Requirements • Line Size & Material Selection • Accuracy versus Cost Trade-Offs*
1230 – 1245	*Break*
1245 – 1315	***Analytical Instrument Design Criteria*** *pH, Conductivity, Oxygen, Gas Analyzers • Sample Conditioning Systems • Sensor Fouling & Cleaning • Calibration Frequency & Access*
1315– 1330	***Instrument Specification Sheets*** *Key Elements of Datasheets • Standard Formats (ISA 20, Vendor Formats) • Material of Construction & Approvals • Electrical & Communication Parameters*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3: Tuesday, 23rd of September 2025

0730 – 0830	***Field Instrument Installation Criteria*** *Location Accessibility • Ambient Conditions (Temperature, Vibration, Humidity) • Orientation & Mounting Support • Protection Against Mechanical Damage*
0830– 0930	***Cable Selection & Routing Design*** *Cable Types (Signal, Power, Twisted Pair, Shielded) • Voltage Drop & Current Carrying • EMC/EMI Considerations • Routing Separation Rules (Signal versus Power)*
0930 – 0945	*Break*
0945 – 1130	***Junction Boxes & Marshaling Panels*** *Layout & Labeling Conventions • Terminal Sizing & Segregation • Cable Gland & Entry Practices • Grounding & Shielding Continuity*

1130 – 1230	***Intrinsically Safe & Explosion Proof Design*** *Zone Classification (ATEX, IECEs) • IS Barriers & Isolators • Enclosure Selection (IP/NEMA Ratings) • Design Approval Documentation*
1230 – 1245	*Break*
1245 – 1315	***Earthing & Grounding Design*** *Functional versus Safety Grounding • Shield Grounding Techniques • Grounding for Surge & Lightning Protection • Earthing Resistance Measurement*
1315– 1330	***Instrument Air System Design*** *Sizing & Pressure Requirement • Air Quality (Dry, Oil-Free) • Manifold & Distribution • Fail-Safe Operation Integration*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4: **Wednesday, 24th of September 2025**

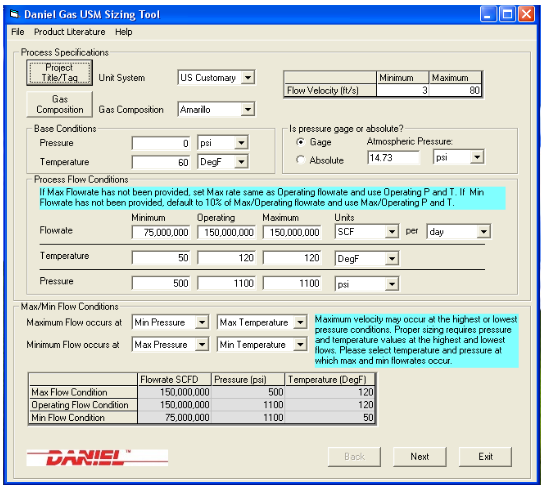
0730 – 0830	***Control Valve Design Criteria*** *Valve Sizing & Cv Calculation • Valve Body, Trim, Actuator Selection • Positioners & Feedback Systems • Noise & Cavitation Prevention*
0830– 0930	***Instrument-to-Control System Integration*** *Signal Types (4-20ma, HART, Modbus, FOUNDATION Fieldbus) • I/O Configuration in Control Systems • Smart Instruments & Diagnostics • Alarm & Trip Logic Interfacing*
0930 – 0945	*Break*
0945 – 1130	***Safety Instrumented Systems (SIS) Design*** *SIL Levels & Risk Analysis (LOPA) • Redundancy & Voting Logic • Safety Relays & Safety PLCs • Test Intervals & Proof Testing*
1130 – 1230	***Communication Protocols & Networking*** *Protocol Selection (Profibus, Ethernet/IP, HART) • Network Topology & Redundancy • Cybersecurity Basics • Integration with SCADA/DCS/PLC*
1230 – 1245	*Break*
1245 – 1315	***Commissioning & Calibration Design Aspects*** *Factory Acceptance Test (FAT) • Site Acceptance Test (SAT) • Calibration Procedures & Tools • Verification Reports & Traceability*
1315– 1330	***Design Reviews & Quality Control*** *Design Document Checklist • Constructability & Operability • HAZOP & Design Risk Assessment • Compliance with Standards & Codes*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5: **Thursday, 25th of September 2025**

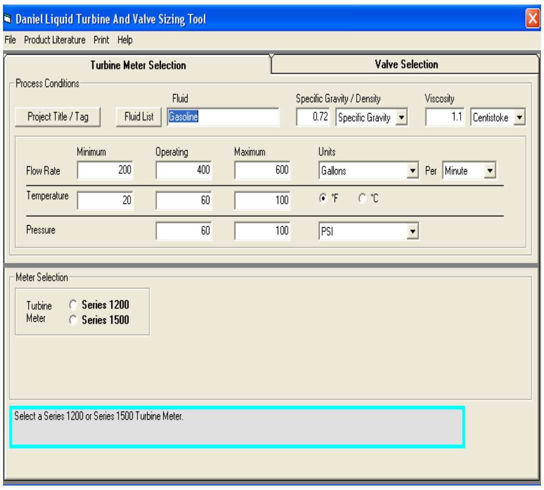
0730 – 0830	***Smart Instrumentation & Digital Technologies*** *IIoT-Enabled Instruments • Wireless Instrumentation (ISA100, Wirelesshart) • Cloud Integration • Predictive Diagnostics & Health Monitoring*
0830– 0930	***Designing for Maintainability & Reliability*** *MTBF, MTTR, Availability Metrics • Hot Swap & Bypass Features • Access & Replaceability • Spare Parts & Lifecycle Planning*
0930 – 0945	*Break*
0945 – 1100	***Instrumentation Design for Harsh Environments*** *Offshore, Desert, Cryogenic, Nuclear Environments • IP Ratings, Enclosure Cooling • Corrosion Protection (SS316, Coatings) • Design for Redundancy & Resilience*
1100 – 1230	***Energy Efficiency & Sustainability in Design*** *Low-Power Devices • Solar-Powered Instrumentation • Remote Monitoring & Optimization • Reducing Compressed Air Usage*
1230 – 1245	*Break*
1245 – 1345	***Case Studies in Instrumentation Design*** *Oil & Gas Process Plant • Power Plant Instrumentation • Water Treatment Plant • Chemical & Pharma Plants*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulator (Hands-on Practical Sessions)

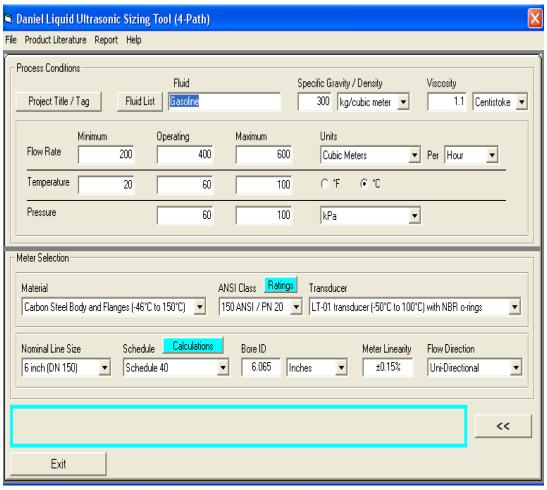
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using one of our state-of-the-art simulators "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter Sizing Tool" and "Orifice Flow Calculator".



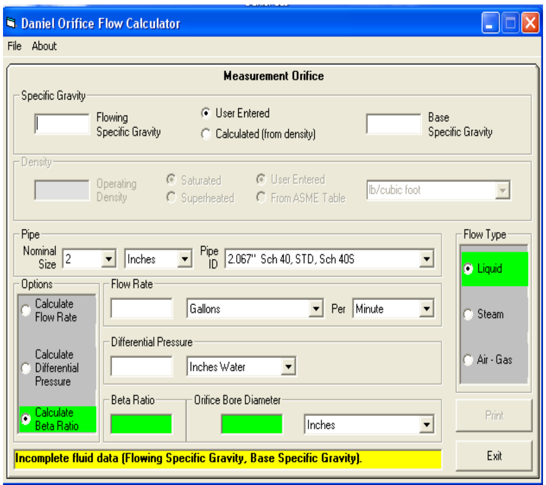
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator

Course Coordinator

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