COURSE OVERVIEW IE0919
Final Control Elements, Valves & Actuators

Course Title
Final Control Elements, Valves & Actuators

Course Date/Venue
please see page 3

Course Reference
IE0919

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 Final Control Elements, Valves & Actuators. It covers the final control elements (FCEs) and the importance in maintaining process variables; the classification of final control elements and control valves as FCEs; the valve types and configurations, valve flow characteristics and valve sizing and selection; the actuators as FCE drivers, pneumatic actuators, electric and electro-hydraulic actuators; the hydraulic actuators including working principle, high-force applications, system components, fluid considerations, maintenance requirements and safety measures; and the valve positioners and controllers and its role in improving accuracy.

During this interactive course, participants will learn the final control element response and dynamics, smart final control elements; the control strategies with FCEs, specialty valves as FCEs and FCE performance testing and standards; the final control elements in safety systems and troubleshooting FCEs, valves and actuators; the mechanical installation of valves and actuators and pneumatic and electrical hook-up; the commissioning of final control elements and routine maintenance of valves and actuators; the valve and actuator overhauling procedures and FCE lifecycle management and reliability; the applications of final control elements by industry; and the energy efficiency and sustainability of FCEs.

Course Objectives

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

- Apply and gain an in-depth knowledge on final control elements, valves and actuators
- Discuss final control elements (FCEs) and its importance in maintaining process variables
- Classify final control elements and identify control valves as FCEs
- Recognize valve types and configurations, valve flow characteristics and valve sizing and selection
- Identify actuators as FCE drivers, pneumatic actuators, electric and electro-hydraulic actuators
- Discuss hydraulic actuators including working principle, high-force applications, system components, fluid considerations, maintenance requirements and safety measures
- Explain valve positioners and controllers and its role in improving accuracy
- Discuss final control element response and dynamics, smart final control elements
- Apply control strategies with FCEs, specialty valves as FCEs and FCE performance testing and standards
- Recognize final control elements in safety systems and troubleshoot FCEs, valves and actuators
- Apply proper mechanical installation of valves and actuators, pneumatic and electrical hook-up, commissioning of final control elements and routine maintenance of valves and actuators
- Implement valve and actuator overhaul procedures and FCE lifecycle management and reliability
- Apply applications of final control elements by industry and discuss energy efficiency and sustainability of FCEs

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 an overview of all significant aspects and considerations of final control elements, valves and actuators for instrumentation and control engineers, process engineers, maintenance and reliability engineers, automation engineers, project engineers and other technical staff.

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 Date/Venue

Session(s)	Date	Venue
1	May 19-23, 2025	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	July 13-17, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE
3	September 22-26, 2025	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
4	November 23-27, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

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 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

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**. 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. John Vorster, MSc, BTech, is a **Senior Instrumentation, Control & Energy Engineer** with over **25 years** of industrial experience within the **Oil**, **Gas**, **Process**, **Refinery**, **Power** and **Nuclear** industries. His wide expertise includes **Energy Management** System Awareness, **Renewable Energy**, **Energy** Conservation & Technologies, **Utility Systems**, **Nuclear** Energy, **Distributed Energy Systems**, **Natural Gas Distribution**, **Field Indication Instruments**, **P&ID** & Technical Specification, **Test Equipment Calibration**, **Field Bus** & **Field Communications**, Testing, Calibration & Maintenance of **Flow**, **Level**, **Pressure & Temperature**, **Loss Control** & **Multiphase Flowmetering**, **Custody Measurement** & **Loss Control**, **Flow Measurement** & **Custody Measurement**, **Flow Computer**, **Turbine Flowmeters**, **Ultrasonic Flowmeter**, **Positive Displacement Flowmeter**, **Coriolis Flowmeter**, **Flow Rate Corrections**, **Pressure Flow Transmitters**, **Pressure Methods**, **Flow Nozzles**, **Orifice Plates**, **Venturi Tubes**, **Pitot Tubes**, **Process Control** Design & Plant Modelling, **Instrumentation**, **Automation**, **Process Control** Instrumentation, **Analyzer** Measurement Systems, **Pressure** Management, Selection & Sizing of all Instrumentation, **SIL** Criteria, Calibration & Configuration of Installed Instrumentation, **PLC & DCS**, **Bearing Replacement** and **Control Valves**. Further, he is also well-versed in HAZOP, LOPA Studies, Radiation Protection, Hazardous Substances, Hazardous Area Classification, Nuclear Devices Maintenance, Loop Drawings, Loop Calculations, Engineering Drawings, Shutdown Maintenance & Planning, Asset Management, Six Sigma, Energy Management & Measurements, Project Management, Strategic Resource Planning, Budget Preparation, ISO 9001, ISO 14000 and ISO 18000 standards. He is currently the **Instrumentation Analyzer & Engineer** of **Sasolburg** wherein he is in-charge of the design and monitoring of the analyzer measurement systems.

During his career life, Mr. Vorster has gained his practical and field experience through his various significant positions and dedication as the **Project Manager**, **Senior Trainer/Instructor**, **Senior Instrumentation Engineer**, **Instrumentation Engineer**, **Green Belt Project Leader**, **Instrumentation Technologist**, **Senior Instrumentation/Electrical Artisan**, **Instrumentation Artisan** and **Apprentice Instrumentation** for numerous international companies including **Sasolburg**, **DOW Chemical Company**, **Safripol** and **Iscor**.

Mr. Vorster has a **Master's** degree in **Engineering Development & Management**, as well as a **Bachelor's of Technology** degree and a **National Diploma** in **Electrical Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), an **Appointed Radiation Protection Officer** and a **Qualified Instrument Mechanician**. Moreover, he is an active member of Project Management Institution (**PMI**) and South African Institute of Measure and Control (**SAIMC**) and has delivered numerous courses, workshops, conferences and seminars internationally.

Course Program

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

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction To Final Control Elements (FCEs)*** *Definition & Role in the Control Loop • Types: Control Valves, Dampers, Variable Frequency Drives • Comparison with Sensors & Controllers • Importance in Maintaining Process Variables*
0930 – 0945	*Break*
0945 – 1030	***Classification of Final Control Elements*** *Power-Operated versus Manually Operated • Linear versus Rotary Motion • Direct Acting versus Reverse Acting • Fail-Safe versus Fail-Fixed*
1030 – 1130	***Control Valves as FCEs*** *Function & Working Principle • Control Valve as the Most Common FCE • Typical Components (Body, Actuator, Positioner) • Applications in Various Industries*
1130 – 1215	***Basic Valve Types & Configurations*** *Globe, Gate, Ball, Butterfly Valves • Single-Seated versus Double-Seated Valves • Control versus Isolation Valves • Valve Body Styles & Trim*
1215 – 1230	*Break*
1230 – 1330	***Valve Flow Characteristics*** *Linear, Equal Percentage, Quick Opening • Inherent versus Installed Characteristics • Selection Based on Process Needs • Control Range & Turndown Ratio*
1330 – 1420	***Valve Sizing & Selection Basics*** *Flow Coefficient (Cv & Kv) • Pressure Drop Calculation • Velocity & Noise Considerations • Sizing Tools & Vendor Software*
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

0730 – 0830	***Basics of Actuators as FCE Drivers*** *Function & Types • Energy Sources: Pneumatic, Hydraulic, Electric • Actuation Force versus Valve Requirements • Control Signal Compatibility*
0830 – 0930	***Pneumatic Actuators*** *Diaphragm versus Piston Types • Spring-Return versus Double-Acting • Air Supply & Pressure Range • Fail-Open/Fail-Close Configuration*
0930 – 0945	*Break*
0945 – 1100	***Electric & Electro-Hydraulic Actuators*** *Motor-Driven Operation • Power Supply & Torque Characteristics • Feedback & Control Systems • Common Failure Modes*
1100 – 1215	***Hydraulic Actuators*** *Working Principle & High-Force Applications • System Components & Fluid Considerations • Maintenance Requirements • Safety Measures*
1215 – 1230	*Break*

1230 – 1330	***Valve Positioners & Controllers*** *Role in Improving Accuracy • Pneumatic, Electro-Pneumatic, Digital Types • Communication Protocols: HART, Fieldbus • Calibration & Diagnostics*
1330 – 1420	***Final Control Element Response & Dynamics*** *Dead Time & Hysteresis • Linearity & Repeatability • Actuator Speed & Stroking Time • Impact on Process Loop Performance*
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

0730 – 0830	***Smart Final Control Elements*** *Integration with Control Systems • Smart Diagnostics & Self-Calibration • Remote Monitoring Capabilities • Benefits in Predictive Maintenance*
0830 – 0930	***Control Strategies with FCEs*** *Proportional, on-Off, & Modulating Control • Position versus Flow-Based Control • Interlocks & Safety Functions • Loop Tuning Considerations*
0930 – 0945	*Break*
0945 – 1100	***Specialty Valves as FCEs*** *Control Ball Valves, V-Port Valves • Angle Valves & Three-Way Valves • Cryogenic & High-Pressure Valves • Slurry & Abrasive Service Valves*
1100 – 1215	***FCE Performance Testing & Standards*** *ANSI/ISA Valve Performance Standards • Bench Testing for Stroke & Leakage • Calibration Procedures • Functional Testing with Control Systems*
1215 – 1230	*Break*
1230 – 1330	***Final Control Elements in Safety Systems*** *Emergency Shutdown Valves (ESDVs) • Safety Instrumented Systems (SIS) Integration • Fail-Safe Mechanisms & SIL Rating • Proof Testing & Verification*
1330 – 1420	***Troubleshooting FCEs, Valves, & Actuators*** *Common Symptoms & Root Causes • Actuator Drift & Air Leaks • Positioner Malfunction • Valve Sticking or Seat Damage*
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

0730 – 0830	***Mechanical Installation of Valves & Actuators*** *Alignment & Support • Gasket & Flange Practices • Torque Specifications • Vibration Considerations*
0830 – 0930	***Pneumatic & Electrical Hook-Up*** *Air Supply Routing & Filtering • Solenoid & Control Wiring • Grounding & Shielding • Intrinsic Safety Requirements*
0930 – 0945	*Break*
0945 – 1100	***Commissioning of Final Control Elements*** *Pre-Commissioning Checks • Stroke Tests & Calibration • Functional Loop Checks • Troubleshooting During Startup*

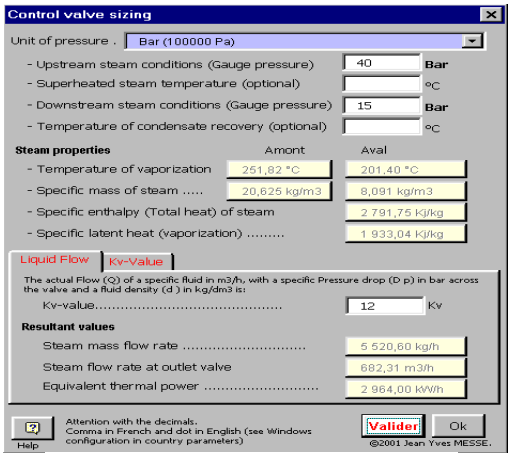
1100 – 1215	***Routine Maintenance of Valves & Actuators*** *Lubrication & Cleaning • Repacking & Seal Inspection • Actuator Service Intervals • Maintenance Logs & History*
1215 – 1230	*Break*
1230 – 1330	***Valve & Actuator Overhaul Procedures*** *Safe Removal & Disassembly • Internal Inspection for Wear • Replacement of Trims & Seals • Reassembly & Bench Testing*
1330 – 1420	***FCE Lifecycle Management & Reliability*** *Mean Time Between Failures (MTBF) • Reliability-Centered Maintenance (RCM) • Spare Part Strategies • Asset Performance Monitoring*
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

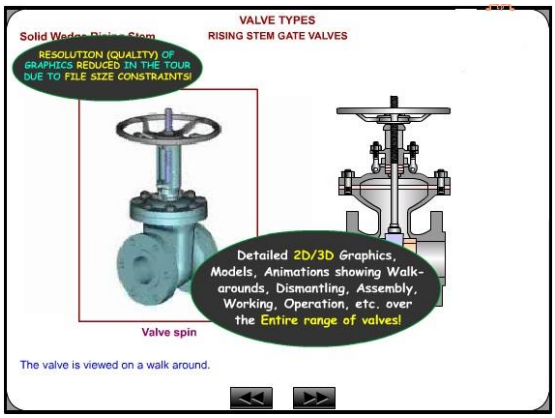
0730 – 0830	***Applications of Final Control Elements by Industry*** *Oil & Gas (ESDVs, Control Valves) • Power Generation (Boiler Feed Control) • Water Treatment (Chlorine Flow Control) • Petrochemical (Pressure Control Valves)*
0830 – 0930	***Energy Efficiency & Sustainability of FCEs*** *Minimizing Pressure Drop • VFDs versus Control Valves • Emission Control with Tight Shut-off • Automation for Energy Savings*
0930 – 0945	*Break*
0945 – 1100	***Case Studies: FCE Failures & Resolution*** *Process Upset Due to Actuator Failure • Cavitation in A Control Valve • Incorrect Valve Sizing • Poor Loop Tuning Impacting FCE Behavior*
1100 – 1230	***Hands-on Workshop: FCE System Setup*** *Valve & Actuator Assembly • Positioner Configuration • Simulated Loop Testing • Diagnostic Tool Usage*
1230 – 1245	*Break*
1245 – 1345	***Hands-on Workshop: Valve & Actuator Calibration*** *Manual Calibration of Positioners • HART Device Communication • Auto-Stroke Tuning • Air Leak Detection & Correction*
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)

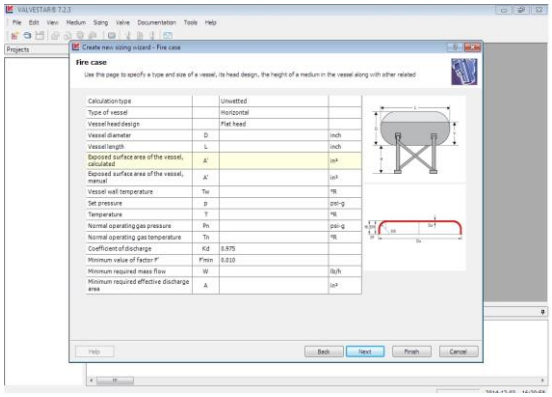
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using one of our state-of-the-art simulators "Valve Sizing Simulator", "Valve Simulator 3.0", "Valvestar 7.2 Simulator" and "PRV²SIZE Simulator".



Valve Sizing Simulator



Valve Simulator 3.0



Valvestar 7.2 Simulator

PRV²SIZE Simulator

Course Coordinator

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