COURSE OVERVIEW EE0854
ABB REF 542 & 545 for Modern Multifunction Protection & Switchgear Control

Course Title
ABB REF 542 & 545 for Modern Multifunction Protection & Switchgear Control



Course Date/Venue
Session 1: January 31-February 04, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar
Session 2: August 01-05, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar

Course Reference
EE0854

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 an up-to-date overview of ABB REF 542 & 545 for modern multifunction protection and switchgear control. It covers the different types of power system faults including their causes, effects and detection; the components of protection schemes that include the application of Programmable Logic Controllers, circuit breakers, current and voltage transformers; the various types of current transformers & voltage transformers; the application requirements of C.T.'s for protective relaying and accuracy classifications; the new numerical technology; the ABB modern power system protective relay families; and the power system neutral grounding for industrial plants and high-voltage substations.

Further, the course will also discuss the ground-fault current and the reasons for limiting generator ground-fault current to a low value; the ground potential rise during power system faults; the proper feeder overcurrent protection; the protective relaying requirements for radial systems, relay setting criteria, load limitations and testing of overcurrent protection scheme; the proper coordination of electrical protection systems; the multifunction protection; the switchgear control unit REF 542plus and REF 542plus motor protection; the measurement supervision NPS and PPS; and the communication interfaces, test equipment and accessories.

Course Objectives/Outcomes & Benefits for the Participants

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

- Apply systematic techniques in ABB REF 542 & 545 for modern multifunction protection and switchgear control
- Identify the different types of power system faults including their causes, effects and detection
- Determine the components of protection schemes including the application of Programmable Logic Controllers, circuit breakers, current and voltage transformers
- Describe the various types of current transformers & voltage transformers, application requirements of C.T.'s for protective relaying and accuracy classifications
- Discuss new numerical technology as well as the ABB modern power system protective relay families including REF and REM
- Discuss the power system neutral grounding for industrial plants and high-voltage substations, calculate ground-fault current and explain the reasons for limiting generator ground-fault current to a low value
- Illustrate the ground potential rise during power system faults which includes the hazards to individuals working in electrical substations, effects of ground-potential-rise (GPR), effects on telecommunications equipment, etc
- Apply the proper feeder overcurrent protection, protective relaying requirements for radial systems, relay setting criteria, load limitations and testing of overcurrent protection scheme
- Recognize the proper coordination of electrical protection systems including bus protection and capacitor protection
- Illustrate multifunction protection and apply switchgear control unit REF 542plus and REF 542plus motor protection
- Control and monitor measurement supervision NPS and PPS as well as identify the communication interfaces, test equipment and accessories

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 ABB REF 542 & 545 for modern multifunction protection and switchgear control for engineers, designers, supervisors and other technical staff.

Course Fee

US$ 6,000 per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day

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**. 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.

Accommodation

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

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. Ahmed Abozeid is a **Senior Electrical Engineer** with over **30 years** of **Onshore** & **Offshore** experience within the **Oil** & **Gas, Refinery**, **Petrochemical** and **Power** industries. His wide expertise covers **HV Cable** Design, **Cable** Splicing & Termination, **Cable** Jointing Techniques, **High Voltage** Electrical Safety, **HV/MV Cable Splicing**, **High Voltage Circuit Breaker** Inspection & Repair, **High Voltage Power System** Safe Operation, High Voltage Safety, **High Voltage Transformers**, Safe Operation of **High Voltage & Low Voltage Power Systems**, **Electric Distribution System Equipment**, Practical Troubleshooting of **Electrical Equipment & Control Circuits**, **Electrical & Control System** Testing & Commissioning, **LV/MV/HV Circuit Breakers** Inspection & Maintenance, Electrical **Power Substation** Maintenance, Practical **High Voltage Safety Operating Procedures**, Modern Power System **Protective Relaying**, **Electrical & Control System** Testing, **Design**, **Commissioning**, **Operation** and **Maintenance** of **Switchgears**, **Transformers**, **Substations**, **Medium & High Voltage Equipment** and **Circuit Breakers**, **Electrical Motors & Variable Speed Drives**, **Motor** Speed Control, Power Electronic Converters, AC Converters Section, Electromagnetic Compatibility (**EMC**), **Motor** Failure Analysis & Testing, **Machinery** Fault Diagnosis, **Bearing** Failure Analysis **Process Control & Instrumentation**, **Process Control Measurements**, **Control System Commissioning & Start-Up**, **Control System & Monitoring**, **Power Station Control System**, **Instrumentation Devices**, **Process Control & Automation**, **PID Controller**, Distributed Control Systems (**DCS**), Programmable Logic Controllers (**PLC**), **ABB PLC & DCS System**, **Gas Analyzers**, **Simulation Testing**, **Load Flow**, **Short Circuit**, **Smart Grid**, **Vibration Sensors**, **Cable Installation & Commissioning**, **Calibration Commissioning** and **Site Filter Controller**. Further, he is also well-versed in **Fundamentals of Electricity**, **Electrical Standards**, **Electrical Power**, **PLC**, **Electrical Wiring**, Machines, **Transformers**, **Motors**, **Power Stations**, **Electro-Mechanical Systems**, **Automation & Control Systems**, **Voltage Distribution**, **Power Distribution**, **Filters**, **Automation System**, **Electrical Variable Speed Drives**, **Power Systems**, **Power Generation**, **Power Transformers**, **Diesel Generators**, **Power Stations**, **Uninterruptible Power Systems** (**UPS**), **Battery Chargers** and **AC** & **DC Transmission**. He is currently the **Project Manager** wherein he manages, plans and implements projects across different lines of business.

Mr. Ahmed worked as the **Electrical Manager**, **Assistant General Technical Manager**, **Electronics & Instruments Head**, **Electrical Power & Machine Expert**, **Electrical Process Leader**, **Team Leader**, **Electrical Team Leader**, **Electronics & Instruments Maintenance Superintendent**, **Engineering Supervisor**, **Technical Instructor** and **Instructor/Trainer** from various companies such as the Lafarge Nigeria, Egyptian Cement Company, ECC Training Center, Alrajhi Construction & Building Company and Ameria Cement Company, just to name a few.

Mr. Ahmed has a **Bachelor's** degree in **Electrical Engineering**. Further, he is a **Certified Instructor/Trainer** and has delivered numerous trainings, seminars, courses, workshops and conferences internationally.

Training Methodology

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities

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

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0845	***Introduction, Overview & Discussion of Objectives***
0845 – 0930	***Power System Faults*** *Different Types of Faults ● Incidence of Faults on Power System Equipment ● Effects of Power System Faults ● Causes of Power System Faults ● Magnitude of Fault Current ● Detection of Faults ● Clearance of Faults ● Requirements of Protective Relaying Systems*
0930 – 0945	*Break*
0945 - 1100	***Components of Protection Schemes*** *Fault Detecting Relays ● The Transition from Electro-mechanical Relays to Electronic and Digital Microprocessor-Based Relays ● Tripping Relays & Other Auxiliary Relays ● The Application of Programmable Logic Controllers ● Circuit Breakers - Bulk-Oil, Air-Blast, Vacuum, SF_6 ● Current Transformers ● Voltage Transformers ● Modern Microprocessor-Based Relays - Review of Types Available*
1100 – 1230	***Current Transformers & Voltage Transformers*** *Various Types of C.T.'s V.T.'s & C.V.T.'s ● Theory and Characteristics of C.T.'s ● Application Requirements of C.T.'s for Protective Relaying ● Accuracy Classifications ● Future Trends in C.T. Design using Optics ● Testing of C.T.'s and V.T.'s*
1230 – 1245	*Break*

1245 – 1420	***Numerical Relays*** *Fundamentals of Numerical Relaying ● Technological Improvements Supplied by Numerical Relays ● Hardware Architecture of Numerical Relays ● Digital Signal Processors ● Sample and Hold Circuit ● Simultaneous Sampling ● Non-simultaneous Sampling ● Relaying Hardware for Metering ● Optical Communications ● Optical Current Transformers ● Open System Relaying*
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 – 0930	***Overview of ABB Modern Power System Protective Relay Families*** *REF ● REM*
0930 – 0945	*Break*
0945 - 1100	***Power System Neutral Grounding*** *An Overview of Power System Neutral Grounding ● System Grounding as Found in Industrial Plants and High-Voltage Substations ● Ungrounded Systems ● Resistance Grounded Systems ● Reactor Grounded Systems ● Solid or Effectively Grounded Systems ● Resistance Grounded Systems in Industrial Plants ● Calculation of Ground-Fault Current ● Ground-Fault Detection on Resistance Grounded Systems ● Ground-Fault Detection on Ungrounded Systems ● Generator Neutral Grounding Methods, Equipment Selection ● Reasons for Limiting Generator Ground-Fault Current to a Low Value ● Neutral Grounding Transformers and Resistors ● Calculation of Generator Ground-Fault Current ● Sizing and Rating of Grounding Equipment*
1100 – 1230	***Ground Potential Rise During Power System Faults*** *Hazards to Individuals Working in Electrical Substations ● Substation Grounding System Fundamentals ● Step Voltage, Touch Voltage, Mesh Voltage ● Tolerable Limits of Body Currents During Power System Faults ● Calculation of Allowable Step and Touch Potentials ● Effects of Ground-Potential-Rise (GPR) ● Control of Excessive Ground-Potential-Rise ● Control of Voltage Gradients in High-Voltage Substations ● GPR and Transferred Voltages ● Effects on Telecommunications Equipment ● Corrective Measures ● Neutralizing Transformers for Telephone Circuits ● Optical Isolation Equipment for Telephone Circuits*
1230 – 1245	*Break*
1245 – 1420	***Feeder Overcurrent Protection*** *Protective Relaying Requirements for Radial Systems ● Elements of Feeder Protection Schemes ● High-Set, Low-Set and Inverse-Timed Elements ● Directional Overcurrent Relays ● Coordination with Other Devices and Fuses ● Various Types of Overcurrent Relays ● Electromechanical, Electronic & Digital Relays ● Relay Setting Criteria ● Load Limitations ● Testing of Overcurrent Protection Schemes ● Microprocessor-Based Feeder Overcurrent Protection Relays-Features, Applications and Testing*
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 – 0930	***Coordination of Electrical Protection Systems*** *Fuse to Fuse ● Circuit Breaker to Fuse ● Fuse to Circuit Breaker ● Computer Software Packages for Protection Coordination Studies ● Auto-Reclosing of Circuit Breakers ● Back-Up Protection ● Limitation of Fault Current ● Selective Zones of Protection*
0930 – 0945	*Break*
0945 - 1100	***Bus Protection*** *Types of Bus Protection Schemes ● Basic Concept of Differential Protection ● Application to Various Bus Configurations ● Application of High Impedance Relays ● Relay Setting Criteria ● Testing of Bus Protection Schemes*
1100 – 1230	***Capacitor Protection*** *Application of Static Capacitors on Power Systems ● Description of Protection Schemes Used ● Testing of Capacitor Protection Schemes ● Microprocessor-Based Capacitor Protection and Controls Relays*
1230 – 1245	*Break*
1245 – 1420	***Multifunction Protection & Switchgear Control Unit REF 542plus*** *3-phase non-directional Overcurrent Protection ● 3-phase Directional Overcurrent Protection ● Non-directional Earth-fault Protection ● Directional Earth-fault Protection ● Residual overvoltage Protection ● 3-phase Thermal Overload (Feeders & Cables) ● 3-phase Undervoltage*
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 – 0930	***Multifunction Protection & Switchgear Control Unit REF 542plus (cont'd)*** *Auto-reclosure ● 3-phase Inrush Detector ● Phase Discontinuity ● Circuit Breaker Failure ● Start-up Supervision for Motors ● Capacitor Bank Protection ● Capacitor Bank Control ● Power Factor Controller ● Power Quality ● Current Waveform Distortion Measurement ● Voltage Waveform Distortion Measurement*
0930 – 0945	*Break*
0945 - 1100	***REF 542plus Motor Protection*** *Motor Protection Functions ● Supervision of a Blocking Rotor ● Setting Parameters ● Functional Check ● Motor Start Protection ● Tripping Characteristic ● Number of Starts Protection ● Thermal Overload Protection ● Setting the Time Constant ● Setting the Temperature ● Behavior During Powering on and off ● Setting the Temperature After Reset*
1100 - 1230	***REF 542plus Motor Protection (cont'd)*** *Unbalanced Load Protection ● Setting the Current Starting Value ● Setting the Tripping Time ● Setting Example ● Rotor Block Protection ● Behavior After Recovering of the Auxiliary Voltage*
1230 – 1245	*Break*
1245 – 1420	***REF 545 Protection Functions*** *Input/output Description ● Configuration ● Measurement Mode ● Parameters and Events ● Circuit Breaker Monitoring ● Parameters and Events*
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 - 0930	***Control & Monitoring*** *Measurement Supervision NPS and PPS ● Input/Output Description ● Configuration ● Measurement Mode*
0930 – 0945	*Break*
0945 - 1100	***Control & Monitoring (cont'd)*** *Operation Criteria ● Setting Groups ● Parameters and Events ● Power Factor Controller*
1100– 1230	***Communication Interfaces*** *System Interface ● IEC 60870-5-103 Protocol ● PROFIBUS-DP ● MODBUS RTU ● DNP 3.0*
1230 – 1245	*Break*
1245 – 1345	***Test Equipment & Accessories*** *Maintenance Tips ● Troubleshooting*
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 (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 "Allen Bradley SLC 500", "AB Micrologix 1000 (Digital or Analog)", "AB SLC5/03", "AB WS5610 PLC", "Siemens S7-1200", "Siemens S7-400", "Siemens SIMATIC S7-300", "Siemens S7-200", "GE Fanuc Series 90-30 PLC", "Siemens SIMATIC Step 7 Professional Software", "HMI SCADA", "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter Sizing Tool" , "Orifice Flow Calculator" and "Automation Simulator".



Allen Bradley SLC 500 Simulator



Allen Bradley Micrologix 1000 Simulator (Digital)



Allen Bradley Micrologix 1000 Simulator (Analog)



Allen Bradley SLC 5/03



Allen Bradley WS5610 PLC Simulator PLC5



Siemens S7-1200 Simulator



Siemens S7-400 Simulator



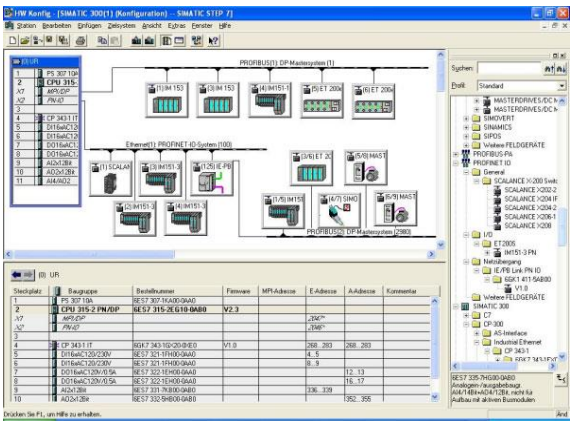
Siemens SIMATIC S7-300



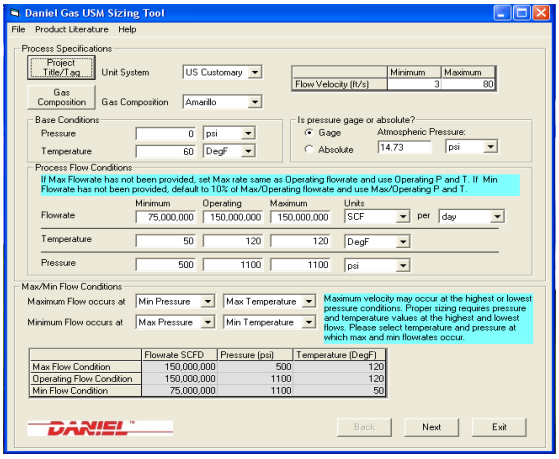
Siemens S7-200 Simulator



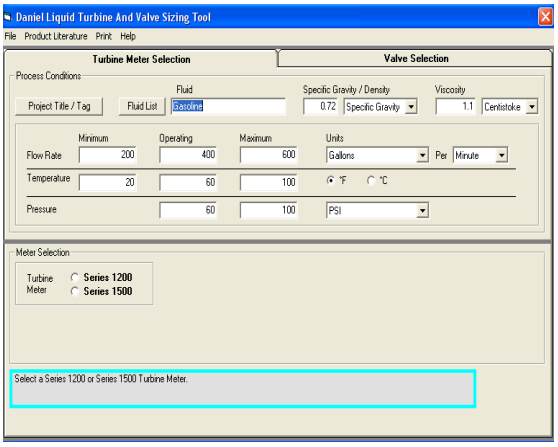
GE Fanuc Series 90-30 PLC Simulator



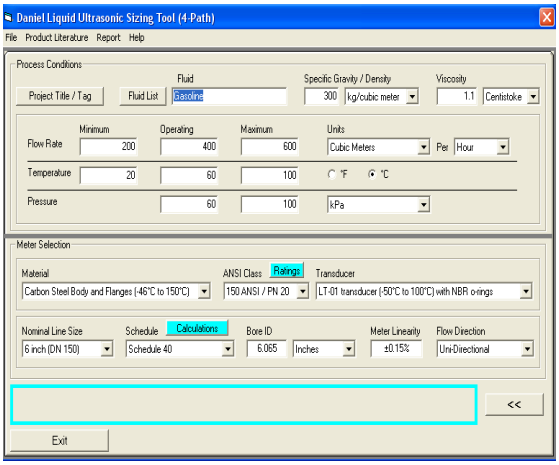
Siemens SIMATIC Step 7 Professional Software



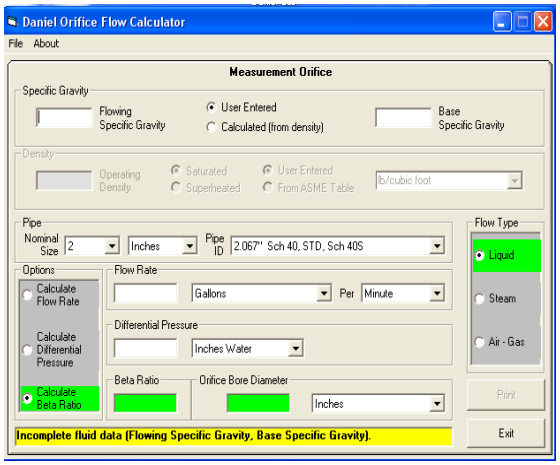
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



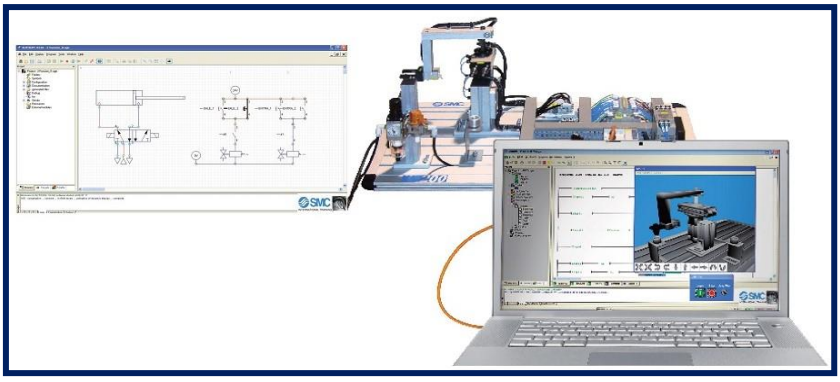
Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator



AutoSIM – 200 Automation Simulator

Course Coordinator
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