

COURSE OVERVIEW PE0569
Process and Hydraulic Simulations - Intermediate
(E-Learning Module)

Course Title

Process and Hydraulic Simulations - Intermediate
 (E-Learning Module)

Course Reference

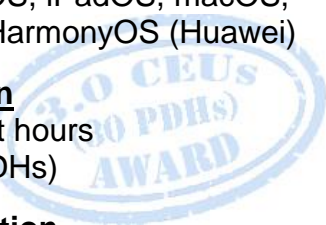
PE0569

Course Format & Compatibility

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration

30 online contact hours
 (3.0 CEUs/30 PDHs)



Course Description



This E-Learning is designed to provide participants with a detailed and up-to-date overview of process and hydraulic simulations. It covers the hydrocarbon processing including the 4 types of hydrocarbons and the most flammable hydrocarbon; the hydraulic simulation and modelling; the 5 basic components of a hydraulic system; calculating hydraulics; the 5 basic components of a hydraulic system and the use of hydraulic track; the purpose of hydraulic; the hydraulics calculation, system models and component models; the pumps, hydraulic software, motors, cylinders, restrictions, spool valves and hydraulic system design; and the hydraulic simulation, modeling and hydraulic circuit diagram.

Further, the course will also cover the importance of hydraulics; the flow and pressure, long lines, accumulators, filters and coolers and the disadvantages of hydraulic system; the use of hydraulic oil instead of water; the hydraulic flow diagram and how much pressure is in a hydraulic system; the fluid power systems, conservation of mass and energy, conservation of momentum and the transient form of momentum conservation; the transient form, steady-state form, orifice flow, turbulent, laminar and pipe model; building an open-loop hydraulic model; creating an open loop system; connecting components; and the complex connections and port connections.

Moreover, the course will also cover the storage and resistive boundary conditions, component pins aid connection and open-loop hydraulic system model; the fluid properties component; calculation of initial conditions; improving the operating point; the steady-state analysis and Newton's method; finding a steady state for the open loop model; reviewing the results of steady state calculation; the linear analysis feature; running a simulation; the settings for open-loop system simulation; reviewing simulation results; the fluid properties; building a closed-loop hydraulic model; the closed-loop hydraulic system; selecting the components for modeling; the model data, steady-state analysis and checking the pilot valve performance; the model of main spool valve and the model mass dynamics of main spool; the directional valve parameters and mass parameters; the correct damping using root locus analysis; the use of steady-state finder to match known conditions; the use of integral control to identify parameters; simulating main spool to check results; applying validation by simulation; and adding piloting pressure forces to the model.

During this interactive course, participants will learn to combine pilotspool and mainspool; add actuator and opposing spring load; complete two-stage valve model and add parameters to actuator and actuator return spring; investigate effect of friction on main spool; define data for restrictions and illustrate schematic formatting; build a raise/lower valve model; simulate a simple raise/lower control for a hydraulic lift; review manufacturer's specification sheet; choose the junction downstream of the valve; set valve characteristics; identify orifice flow areas and finish parameterization; test the raise/lower valve model; use icon editor; initiate transients during simulation and consider conservation of momentum; replace noncavitating component; model pressure wave transients; calculate theoretical pressure rise; and connect calculator to model.

Course Objectives

At the end of this course, the Trainee will be able to:-

- Apply and gain a good working knowledge on process and hydraulic simulations
- Explain the required process technical data and importance of each parameter in order to set up process simulation models
- Collect and verify required data (process parameter values and fluid properties) for simulation process model set up
- Describe how to prepare and run basic process models (such as utilities, 3-phase separation, gas compression, etc.) and integrated facilities process simulations
- Operate steady state simulation program model (such as PRO-II or UNISIM) to monitor unit and equipment performance
- Describe how to carry out analysis of process simulation model output data
- Record, analyse and interpret simulation results
- Calculate various process parameters and conduct optimisation exercises utilising process simulation models
- Describe main differences between steady state and dynamic modelling

- Analyse start-up, shutdown, utility-failure, ESD and major process upset scenarios
- Transfer and capture results into relevant KOC software packages
- Discuss hydrocarbon processing including the 4 types of hydrocarbons and the most flammable hydrocarbon
- Illustrate hydraulic simulation and modelling as well as identify the 5 basic components of a hydraulic system
- Calculate hydraulics as well as recognize the 5 basic components of a hydraulic system and the use of hydraulic track
- Explain the purpose of hydraulic and illustrate hydraulics calculation, system models and component models
- Determine pumps, hydraulic software, motors, cylinders, restrictions, spool valves and hydraulic system design
- Illustrate hydraulic simulation and modeling and hydraulic circuit diagram as well as discuss the importance of hydraulics
- Identify flow and pressure, long lines, accumulators, filters and coolers and the disadvantages of hydraulic system
- Use hydraulic oil instead of water, describe hydraulic flow diagram and identify how much pressure is in a hydraulic system
- Recognize fluid power systems, conservation of mass and energy, conservation of momentum and the transient form of momentum conservation
- Determine transient form, steady- state form, orifice flow, turbulent, laminar and pipe model
- Build an open-loop hydraulic model, create an open loop system, connect components and identify complex connections and port connections
- Recognize storage and resistive boundary conditions, component pins and connection, open-loop hydraulic system model and fluid properties component
- Calculate initial conditions, improve the operating point, apply steady-state analysis and review Newton's method
- Find a steady state for the open loop model, review the results of steady state calculation and explain the linear analysis feature
- Run a simulation, discuss the settings for open-loop system simulation, review simulation results and identify fluid properties
- Build a closed-loop hydraulic model, recognize closed-loop hydraulic system and select the components for modeling
- Define model data, apply steady-state analysis and always find a valid operating point before simulating
- Check the pilot valve performance, begin model of main spool valve and illustrate the model mass dynamics of main spool

- Describe directional valve parameters and mass parameters, identify correct damping using root locus analysis and use the steady-state finder to match known conditions
- Use integral control to identify parameters, simulate main spool to check results, apply validation by simulation and add piloting pressure forces to the model
- Combine pilotspool and mainspool, add actuator and opposing spring load, complete two-stage valve model and add parameters to actuator and actuator return spring
- Investigate effect of friction on main spool, define data for restrictions and illustrate schematic formatting
- Build a raise/lower valve model, simulate a simple raise/lower control for a hydraulic lift and review manufacturer's specification sheet
- Choose the junction downstream of the valve, set valve characteristics, identify orifice flow areas and finish parameterization
- Test the raise/lower valve model, use icon editor, initiate transients during simulation and consider conservation of momentum
- Replace noncavitating component, model pressure wave transients, calculate theoretical pressure rise and connect calculator to model

Should Attend

This course provides an overview of all significant aspects and considerations of process and hydraulic simulations for those directly involved in gas processing operations. However, the course is specifically designed to be of benefit to both technical and non-technical personnel employed in the activities that support the industry. Managers, engineers, marketing staff, and manufacturer's representatives, as well as individuals involved in sales and services to the natural gas industry will receive considerable benefit from the overview.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test


Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -


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USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association 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 1-2013 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 1-2013 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 Association 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.

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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.

Course Fee

As per proposal

Course Contents

- What is hydrocarbon processing?
- What does hydrocarbon mean?
- What is the hydrocarbon industry?
- What are the 4 types of hydrocarbons?
- What are 5 common hydrocarbons?
- Most Flammable hydrocarbon
- Hydraulic simulation and modelling
- What is a hydraulic and how does it work?
- What is the purpose of simulation software?
- What are the 5 basic components of a hydraulic system?
- What are 4 types of models?
- Top 7 Simulation Software in 2018
- The Section Quiz
- How do you calculate hydraulics?
- What is hydraulic process?
- What are the basics of hydraulics?
- The 5 basic components of a hydraulic system
- What is the use of hydraulic track?
- What are examples of hydraulics?
- What is the science behind hydraulics?
- What are hydraulics and pneumatics?
- The Section Quiz
- Basic Principals
- 5 Basics
- What is a hydraulic and how does it work?
- Hydraulics
- Hydraulic system simple definition
- The purpose of hydraulic
- Hydraulics Calculation
- System Models
- The Section Quiz



- Component Models
- Pumps
- Hydraulic Software
- Motors
- Cylinders
- Case Study
- Illustrative Video
- The Section Quiz
- Hydraulic Simulation Software
- Restrictions
- Spool Valves
- Case Study
- Illustrative Video
- The Section Quiz
- Hydraulic System design
- 5 basic components of a hydraulic system
- Hydraulic simulation and modeling
- Hydraulic circuit diagram
- Importance of hydraulics
- Hydraulic Software
- Case Study
- Illustrative Video
- The Section Quiz
- Flow and Pressure
- Long Lines
- Accumulators
- Filters and Coolers
- Hydraulic Systems Software
- Case Study
- Illustrative Video
- The Section Quiz
- What does P and T mean in hydraulics?
- Disadvantages of hydraulic system





- Hydraulic Modeling Software
- Using hydraulic oil instead of water
- Basics of Hydraulics
- Case Study
- Illustrative Video
- The Section Quiz
- Liquids Used in Hydraulics
- Hydraulic flow diagram?
- Hydraulic System Software
- Pilot mean in hydraulics
- Why simulation is needed?
- Case Study
- Illustrative Video
- The Section Quiz
- Hydraulic flow diagram
- How much pressure is in a hydraulic system?
- Hydraulic System Software
- Supportive Program
- Case Study
- Illustrative Video
- The Section Quiz
- Modeling and Simulation of Fluid Power Systems Using MSC.EASY5
- Fluid Power Systems Class Introduction
- Overview of MSC.EASY5
- MSC.EASY5 Overview
- A Brief Overview of the HC Library
- HC Library Overview
- Governing Equations
- Conservation of Mass
- Conservation of Energy
- Conservation of Momentum, Transient Form
- Conservation of Momentum, Steady State Form
- The Transient Form of Momentum Conservation





- Computational Implications of Choice of Momentum Model
- Transient form
- Steady- state form
- Orifice Flow
- Turbulent
- Laminar
- Switch State Representation of Orifice Flow Regimes
- Pipe Model
- Building an Open-Loop Hydraulic Model
- Building a Model
- Create an Open Loop System
- Connect Components
- Complex Connections
- Port Connections
- Storage and Resistive Boundary Conditions
- Component Pins Aid Connection
- Open-Loop Hydraulic System Model
- Fluid Properties Component
- Hydraulic Loop Source File
- Creating the Executable
- MSC.EASY5
- MSC.EASY5 Model Generator
- MSC.EASY5 model of your system
- State variables are those defined by ordinary differential equations
- Algebraic variables are just called variables in MSC.EASY5
- Define Model Data
- Calculate Initial Conditions
- Improving the Operating Point
- Steady-State Analysis
- Review of Newton's Method
- Not All Systems have a Steady State
- Finding a Steady State for the Open Loop Model
- Results of Steady State Calculation





- Linear Analysis Feature
- Running a Simulation
- Settings for Open-Loop System Simulation
- Simulation Results
- Fluid Properties
- Fluid Properties with Function Calls
- Building a Closed-Loop Hydraulic Model
- Closed-Loop Hydraulic System
- Selection of Components for Modeling
- HC Heat Exchangers
- Define Model Data
- Steady-State Analysis
- Steady-State Analysis Output Listing File
- Troubleshooting
- Two-Step Steady-State Solution
- Always Find a Valid Operating Point Before Simulating
- Other Important Points Concerning Steady State
- Run a Simulation
- Building a 2-Stage Piloted Servo Valve
- Plan for Design of 2-Stage Valve
- Model 3: Pilot Valve
- Make Component Connections
- Parameters for MSC.EASY5 Servo Valves
- Add Data to the Pilot Valve Model
- Completed Pilot Test Model
- Check the Pilot Valve Performance
- Begin Model of Main Spool Valve
- Model Mass Dynamics of Main Spool
- Directional Valve Parameters
- Mass Parameters
- Identify Correct Damping Using Root Locus Analysis
- Using the Steady-State Finder to Match Known Conditions
- Using Integral Control to Identify Parameters





- Simulate Main Spool to Check Results
- Validation by Simulation
- Add Piloting Pressure Forces to the Model
- Combine PilotSpool and MainSpool
- Add Actuator and Opposing Spring Load
- Complete Two-Stage Valve Model
- Add Parameters to Actuator
- Add Parameters to Actuator Return Spring
- Steady-State Problems with Valves and Actuators
- Simulate
- Investigate Effect of Friction on Main Spool
- Friction Changes Response of Actuator
- Modeling Manifolds: Splits and Merges
- Modeling Splits and Merges
- Define Data for Restrictions
- Define Data in Tables
- Schematic Formatting
- Building a Raise/Lower Valve Model
- Simulating a Simple Raise/Lower Control for a Hydraulic Lift
- Manufacturer's Specification Sheet
- Choose the Junction Downstream of the Valve
- Some Alternative Constructions That Work
- Some Options Can Cause Simulations to Fail
- Completing the Raise/Lower Valve
- Setting Valve Characteristics
- Identify Orifice Flow Areas
- Finish Parameterization
- Test the Raise/Lower Valve Model
- Flows Through Both Ports
- Using the Icon Editor
- Construct the Raise/Lower System Using the Valve Submodel
- Parameterizing the Raise/Lower Model
- Instrument the Raise/Lower Model





- Initiating Transients During Simulation
- Considering Conservation of Momentum: Modeling Waterhammer
- Modeling Pressure Transients
- Test Model for Transient Momentum Study
- Negative Pressures in an MSC.EASY5 Model
- Replace Noncavitating Component
- Modeling Pressure Wave Transients
- Calculate Theoretical Pressure Rise
- Connect Calculator to Model
- Hints on Modeling Pressure Transients
- What to Do When Disaster Strikes: Debugging Hydraulics Models
- Classes of Problem Symptoms
- Simulations Don't Start
- Simulations work for a while, then get stuck.
- Simulations Suddenly Stop
- Other Problems

