COURSE OVERVIEW DE0939
Oil Well Testing
(E-Learning Module)

Course Title
Oil Well Testing (E-Learning Module)

Course Reference
DE0939

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 course is designed to provide participants with a detailed and up-to-date overview of oil well testing. It covers the well testing and well and completion design; perforating and well testing; the fundamental of fluid flow in petroleum reservoirs and fundamentals of well test theory; the basis of transient well testing analysis, pressure drawdown and build up tests; well testing, logistics process and flowhead or test tree; the objectives of well test operations and DST assembly using two straddle packers; the open hole and cased hole drill stem testing; the typical MFE openhole string and typical MFE inflate openhole string; the potential hazards, possible solutions and some specialized well test types; the multiple-well testing, interference testing and pulse testing; the intelligent remote implementation system (IRIS); the Huisman's and Jacob's modified correction method; and the confined, leaky and unconfined anisotropic aquifers.

Further, the course will also discuss the recovery test, residual drawdown, Theis recovery method and recovery test after constant discharge and drawdown test; the Theis's recovery method for leaky aquifers, unconfined aquifers and partially penetrating wells; the variable-discharge tests and tests in well fields using Birsoy-Summer's method; the intermittent pumping, step-wise pumping and free-flowing wells; and the Hantush-Bierschenk's method, Eden-Hazel's method, Rorabaugh's method and Sheehan's method.

During this course, participants will learn the skin factor and apply methods to analyze single-well tests; the constant discharge methods comprising of Papadopulos-Cooper's method, Rushton-Singh's ration method, Jacob's straight line method, Hurr-Worthington's method, Theis's recovery method and etc.; the reservoir engineering objectives, reservoir rock properties; the porosity, rock matrix and pore space and permeability; the effect of grain size on permeability, fluid saturation, in-situ saturation, wettability and capillary pressure; the 3-PVT and phase behavior of petroleum reservoir fluids and petroleum reservoir fluid composition; the API classification for crude oil and phase behavior of a single-component; the 3-D diagram of single-component system, phase diagram for two pure components, phase diagram of a typical black oil, retrograde gas and dry gas; the five reservoir fluids and PVT analysis relationships; the reservoir drive mechanisms, producing characteristics and reservoir depletion concepts; the reservoir solution gas drive mechanism and gravity drive mechanism; the pressure transient testing, reservoir/well testing and review schematic diagram of a well test; the drawdown test, pressure buildup test, multi-rate test, drill stem test, well test and reservoir characterization; the well testing analysis techniques, mechanisms governing transient testing, diffusivity equation and derivation of the diffusivity equation; the continuity equation, Darcy's law, equation of state and diffusivity equation; the reservoir flow regime, transient flow and pseudo-steady-state flow (PSS); and the solution for the diffusivity equation and constant terminal pressure rate solution.

Course Objectives

After completing the course, the employee will:-

- Apply and gain a comprehensive knowledge on oil well testing
- Discuss well testing as well as discuss well and completion design
- Demonstrate perforating and well testing as well as discuss the fundamental of fluid flow in petroleum reservoirs and fundamentals of well test theory
- Recognize the basis of transient well testing analysis and employ pressure drawdown and build up tests
- Describe well testing, logistics process and flowhead or test tree
- Carryout the objectives of well test operations and DST assembly using two straddle packers
- Employ open hole and cased hole drill stem testing including drill stem test assembly
- Identify the typical MFE openhole string and typical MFE inflate openhole string
- Recognize potential hazards and possible solutions including some specialized well test types
- Carryout multiple-well testing, interference testing and pulse testing
- Describe intelligent remote implementation system (IRIS)
- Discuss Huisman's and Jacob's modified correction method

- Identify confined, leaky and unconfined anisotropic aquifers
- Employ recovery test, residual drawdown, Theis recovery method and recovery test after constant discharge and drawdown test
- Apply Theis's recovery method for leaky aquifers, unconfined aquifers and partially penetrating wells
- carryout variable-discharge tests and tests in well fields using Birsoy-Summer's method
- Describe intermittent pumping, step-wise pumping and free-flowing wells
- Demonstrate Hantush-Bierschenk's method, Eden-Hazel's method, Rorabaugh's method and Sheehan's method
- Determine skin factor and apply methods to analyze single-well tests
- Discuss constant discharge methods comprising of Papadopulos-Cooper's method, Rushton-Singh's ration method, Jacob's straight line method, Hurr-Worthington's method, Theis's recovery method and etc.
- Explain reservoir engineering objectives and determine reservoir rock properties, porosity, rock matrix and pore space and permeability
- Identify the effect of grain size on permeability and illustrate fluid saturation, in-situ saturation, wettability and capillary pressure
- Recognize 3-PVT and phase behavior of petroleum reservoir fluids as well as describe petroleum reservoir fluid composition
- Discuss API classification for crude oil and phase behavior of a single-component
- Illustrate 3-D diagram of single-component system, phase diagram for two pure components, phase diagram of a typical black oil, retrograde gas and dry gas
- Identify the five reservoir fluids and PVT analysis relationships
- Describe reservoir drive mechanisms and producing characteristics as well as reservoir depletion concepts
- Recognize reservoir solution gas drive mechanism and gravity drive mechanism
- Carryout pressure transient testing and reservoir/well testing as well as review schematic diagram of a well test
- Employ drawdown test, pressure buildup test, multi-rate test, drill stem test and well test including reservoir characterization
- Apply well testing analysis techniques, mechanisms governing transient testing, diffusivity equation and derivation of the diffusivity equation
- Discuss continuity equation, Darcy's law, equation of state and diffusivity equation
- Demonstrate reservoir flow regime and describe transient flow, pseudo-steady-state flow (PSS)
- Identify solution for the diffusivity equation and constant terminal pressure rate solution

Who Should Attend
This course provides an overview of all significant aspects and considerations of oil well testing for reservoir engineers, production engineers, petroleum engineers, production supervisors and others technical staff needing a practical understanding of well testing operations.

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:-

- 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.

- 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

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 Contents

- Introduction to Well Testing
- Well design
- Completion design
- Wellhead design design
- Perforating
- Well Testing
- Fundamental of Fluid Flow in Petroleum Reservoirs
- Basis of Transient Well Testing Analysis
- Fundamentals of Well Test Theory
- Pressure Drawdown & Build up Tests
- Fundamentals
- Other Well Tests
- What is Welltesting
- Why Welltesting
- Logistics process
- Flowhead or test tree
- Sand Filter
- Choke Manifold

- Heater
- Separator
- Surge tank
- Gauge Tank
- Flare Booms
- Temporary Piping
- Well tests
- OBJECTIVES OF WELL TEST OPERATIONS
- Drill Stem Test (DST)
- Drill stem test function
- DST assembly using two straddle packers
- Open Hole Drill Stem Testing
- Cased Hole Drill Stem Testing
- Typical MFE Openhole String - Typical MFE Inflate Openhole String
- Drill stem test assembly - Other Equipment Involved
- Test Tree
- Test Choke
- Potential Hazards
- Possible Solutions
- Some Specialized well Test Types
- Multiple-well testing
- Interference testing
- Type-curve match of an interference test
- Pulse testing
- New Technology
- Intelligent Remote Implementation System (IRIS)
- Partially Penetrating Wells
- Corrections
- Confined aquifers (steady-state)
- Huisman's Correction Method II
- Confined Aquifers (unsteady-state): Modified Hantush's Method
- Confined Aquifers (unsteady-state): Modified Jacob's Method
- Leaky Aquifers (steady-state)

- Leaky Aquifers (unsteady-state): Weeks's modification of Walton and Hantush curve-fitting method
- Unconfined Anisotropic Aquifers (unsteady-state): Streltsova's curve-fitting method
- Cross section of an unconfined anistropic aquifier pumped by a partially penetrating well
- Unconfined Anisotropic Aquifers (unsteady-state): Neuman's curve-fitting method
- Recovery Test
- Residual Drawdown
- Theis Recovery Method
- Recovery Test after Constant Discharge Test
- Theis's Recovery Method for Leaky Aquifers
- Theis's Recovery Method for Unconfined Aquifers
- Theis's Recovery Method for Partially Penetrating Wells
- Recovery Test after a Constant Drawdown Test
- Variable-discharge tests and tests in well fields
- Variable-discharge tests - Confined Aquifers, Birsoy-Summer's Method
- Intermittent Pumping
- Step-wise Pumping
- Variable-discharge tests - Confined Aquifers, Aron-Scott's Method
- Free-Flowing Wells
- Free-flowing wells - Confined aquifer, unsteady-state flow, Hantush's Method
- Free-flowing wells - Leaky aquifer, steady-state flow, Hantush-DeGlee's method
- Assumptions
- Recovery Test After Variable-Discharge Test
- Well-Performance Tests - Analysis and Evaluation of Pumping Test Data
- Head Losses in a Pumped Well
- Step-Drawdown Test
- Variation to Jacob's Equation
- Well Efficiency
- Total Drawdown Inside a Well due to Well Losses
- Hantush-Bierschenk's Method

- Eden-Hazel's Method
- Rorabaugh's Method
- Sheahan's Method
- Determination of the Skin Factor
- AQTESOLV
- Single Well tests
- Methods to analyze Single-well tests
- Constant Discharge
- Variable-Discharge
- Recovery Tests
- Constant Discharge Methods
- Papadopulos-Cooper's Method 1: assumptions
- Papadopulos-Cooper's Method 2: The Equation
- Papadopulos-Cooper's Method 3: remarks
- Rushton-Singh's ratio Method 1: Assumpions/uses
- Rushton-Singh's ratio Method 2: Equation
- Rushton-Singh's ratio Method 3: Remarks
- Jacob's Straight Line Method 1: Uses/Assumptions
- Jacob's Straight Line Method 2: Remarks
- Hurr-Worthington's Method 1: assumptions/Uses
- Hurr-Worthington's Method 2: The Equation
- Hurr-Worthington's Method 3: Remarks
- Variable Discharge Methods
- Birsory-Summers's Method
- Jacob-Lohman's free flowing-well method 1: Assumptions
- Jacob-Lohman's free flowing-well method 2: Equation
- Leaky aquifters, Hantush's free-flowing well method 1 : Assumptions
- Leaky aquifters, Hantush's free-flowing well method 2 : Equation
- Theis's Recovery Method 1: Assumptions
- Theis's Recovery Method 2: Remarks
- Birsoy-Summers's Recovery Method
- Eden-Hazel Method : uses/Assumptions
- Slug Tests

- Background
- Types of Slug Tests
- Cooper's Method (1967)
- Cooper's Method: Assumptions
- Remarks
- Uffink's Method
- Uffink's Method: Assumptions and Conditions
- Bouwer-Rice's Method
- Bouwer-Rice's Method: Assumptions and Conditions
- Bouwer-Rice's Method: Remarks
- Advanced Well Testing
- The Reservoir
- Reservoir Engineering Objectives
- Basic Area Of Knowledge
- Reservoir Rock Properties
- Porosity
- Rock Matrix and Pore Space
- Permeability
- Effect of Grain Size on Permeability
- Fluid Saturation
- Saturation vs Grain Size
- In-Situ Saturation
- Wettability & Capillary Pressure
- Contact Angle as a Measure of Wetting
- Oil-Water Contact : Transition Zone
- 3-PVT & PHASE BEHAVIOUR OF PETROLEUM RESERVOIR FLUIDS
- PETROLEUM RESERVOIR FLUID COMPOSITION
- Two models are used to describe the composition for physical property prediction purposes
- API classification for the crude oil according to the following Equ. - Phase Diagram For A Pure Substance: [P/T Diagram]
- API classification for the crude oil according to the following Equ. - Phase Diagram For A Pure Substance: [P/V Diagram]
- Phase Behaviour of a Single-Component

- HYDR. PHASE-BEHAVIOUR- PURE SUBSTANCES - Phase Diagram For A Pure Substance: [P/V Diagram]
- HYDR. PHASE-BEHAVIOUR- PURE SUBSTANCES - Phase Diagram For Two Component Mixture: [P/V Diagram]
- HYDR. PHASE-BEHAVIOUR- PURE SUBSTANCES - Phase Diagram For Two Component Mixture: [P/T Diagram]
- 3-D Diagram of Single-Component System
- Phase Diagram for Two Pure Components
- HYDR. PHASE-BEHAVIOUR- PURE SUBSTANCES - Phase Diagram For Multi Component Mixture: [P/T Diagram]
- CLASSIFICATION OF RESERVOIR FLUIDS - Oil Reservoir "Dissolved Gas in Solution" [Tr <Tc]
- Fluids and Fluid Types - The Effect of Separator Pressure
- The Main Five Reservoir Fluids
- Phase Diagram of a Typical Black Oil
- Phase Diagram of a Typical Retrograde Gas
- Phase Diagram of Typical Dry Gas
- The Five Reservoir Fluids
- Field Identification
- PVT ANALYSIS RELATIONSHIPS
- Volumes in Surface vs. Downhole
- PVT PARAMETERS
- PVT SAMPLES
- Reservoir Drive Mechanisms and Producing Characteristics
- RESERVOIR DEPLETION CONCEPTS
- Oil Reservoir Drive Mechanisms
- Reservoir Energy Sources
- Solution-Gas Drive in Oil Reservoirs
- RESERVOIR - SOLUTION GAS DRIVE MECHANISM
- Solution-Gas Drive in Oil Reservoirs Formation of a Secondary Gas Cap
- Gas-Cap Drive in Oil Reservoirs
- Gas-Cap Drive in Oil Reservoirs Typical Production Characteristics
- Water Drive in Oil Reservoirs - Edgewater Drive
- Water Drive in Oil Reservoirs - Bottomwater Drive

- Water Drive in Oil Reservoirs - Typical Production Characteristics
- RESERVOIR - GRAVITY DRIVE MECHANISM
- Combination Drive in Oil Reservoirs
- Average Recovery Factors - Oil Reservoirs
- PREPARATION AND USE OF WELL-TEST REPORTS
- WELL TESTS -GENERAL
- RESPONSIBILITY FOR TEST
- PREPARATION FOR TEST WELL
- Stabilization
- Equipment Check – Problems
- Pressure Transient Testing
- Reservoir/Well Testing
- Schematic Diagram of a Well Test
- Typical Job Sequence
- Test Types
- Drawdown Test
- Pressure Buildup Test
- Multi-rate Test
- Drill Stem Test – Flow to Surface
- Well Test – Field Case
- Objectives for Transient Testing
- Reservoir Engineers
- Reservoir characterization
- Exploration well
- Appraisal well
- Development well
- Well Testing Analysis Techniques
- Mechanisms Governing Transient Testing
- Diagram of the Reservoir and Well
- Diffusivity Equation
- Derivation of the Diffusivity Equation
- Continuity Equation – Mass Conservation
- Darcy’s Law – Flow Through Porous Media

- Equation of State – Liquid
- Diffusivity Equation – Liquid
- Diffusivity Equation
- Reservoir Fluid Flow Regime
- Transient Flow
- Pseudo-Steady-State Flow (PSS)
- Steady-State Flow (SS)
- Solution for the Diffusivity Equation
- Constant terminal rate solution (inner boundary)
- Constant terminal pressure solution (inner boundary)
- Bounded cylindrical reservoir, constant-pressure outer boundary (SS)
- Bounded cylindrical reservoir, no-flow outer boundary (PSS)
- Infinite reservoir, line source well (Transient)
- Solution Derivation Using the Boltzman Transform
- Infinite reservoir, line source well (Transient)
- Applicability of line source solution
- Diffusivity Equation
- Limiting Forms
- Flow States – Transient
- Flow States – Pseudo-Steady State (PSS)
- Flow States – Steady State
- Well Testing (II)
- Type Curve
- Agarwal Type Curve
- Type Curve Matching
- Gringarten Type Curve
- Bourdet's Derivative Plot (1983)
- Wellbore Storage Effect (WBS)
- Infinite Acting Radial Flow (IARF)
- Combined Gringarten and Bourdet Plot
- The Pressure Derivative
- Flow Regimes
- Radial Flow Regimes for Vertical Wells

- Spherical Flow Regimes
- Linear Flow Regimes
- Flow Regime Identification
- Flow Region Identification
- Time Region Identification
- Early and Middle Time Analysis
- Drawdown Analysis
- Cartesian Drawdown Analysis – C
- Semi-log Drawdown Analysis – s
- Log-Log Drawdown Analysis – C
- Log-Log Drawdown Analysis – k, s
- PBU Analysis (straight line methods)
- PBU Analysis
- Cartesian PBU Analysis – C
- Horner PBU Analysis – k, p*
- Horner PBU Analysis – s
- Log-Log PBU Analysis – C, k, s
- Log-Log PBU Analysis – C
- Log-Log PBU Analysis – k, s
- Finite Conductivity Hydraulic Fracture
- Late Time Analysis
- Late-Time Analysis: Outer Boundary
- Closed Boundary – PSS Flow
- Rectangular Drainage Area
- Boundary Models – Single Sealing Fault
- Semi-log Plot
- Dimensionless Pressure Derivative Plot
- Intersecting Fault
- Time Region Analysis
- Well Testing Analysis Procedures
- Cutting-Edge Well Testing Technique
- Permanent Downhole Gauge