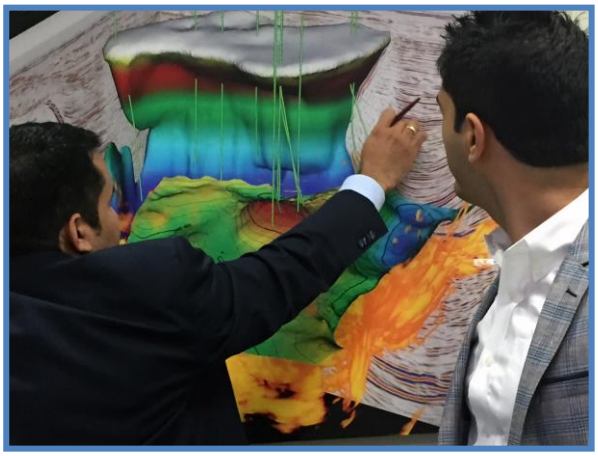
COURSE OVERVIEW DE0731
Fluid Properties and Phase Behavior (PVT) (E-Learning Module)

Course Title
Fluid Properties and Phase Behavior (PVT) (E-Learning Module)

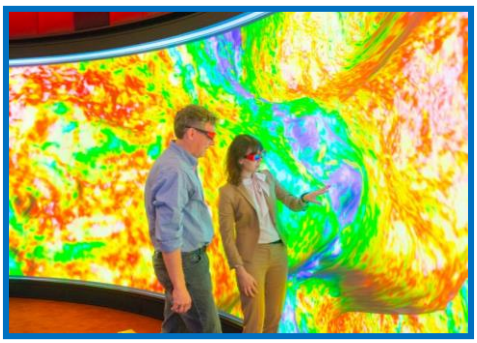


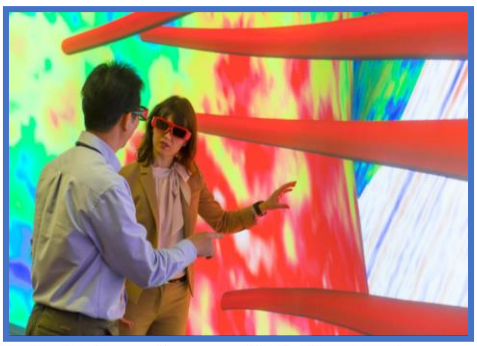
Course Reference
DE0731

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





Accurate information on phase behaviour and properties of fluids is an essential element in proper management of petroleum reservoirs. Reservoirs were often produced by depletion in which the reservoir pressure was the main variable that controlled the fluid properties. Thus, understanding phase behaviour is an important step for modeling EOR and be prepared for the coming phase of development of the oil fields. Hence, experimental methods and predictive correlations with pressure as the variable were developed and successfully used for many years in industry.

The development of enhanced oil recovery techniques and growing interest in gas condensate and volatile oil reservoirs, involving wide compositional variations and complex fluid behaviour during production, necessitated the use of more advanced compositional methods and new experimental procedures. The availability of high computational capabilities greatly assisted the rapid technology development in this area and its wide use in industry.

This E-Learning is designed to present practical methods of determining required reservoir fluid properties for engineering applications by judicious review of conventional practices and introducing recent advances. Although the emphasis is on the application of PVT and phase behaviour data to engineering problems, experimental methods will also be reviewed and their limitations will be identified.

The course covers data gathering and fluid sampling that enable engineers to deliver a proper fluid characterization (from sampling to EOS characterization). This course will enable the participants to ensure optimum sampling strategy, strong laboratories follow-up capabilities and high-quality EOS characterization.

Course Objectives

After completing the course, the employee will:-

- Apply and gain an in-depth knowledge on fluid properties and phase behavior (PVT)
- Understand the Introduction to rock mechanics and geomechanical principles
- Understand rock mechanical properties- pressure, stresses, and loads
- Understand geomechanics and borehole stability
- Understand wellbore and in-situ (earth) field measurement
- Understand stress orientation techniques
- Understand elastic, plastic, and viscous models of rock behavior
- Understand fracture mechanics
- Understand reservoir engineering applications
- Understand wireline log predicted mechanical properties data integration
- Correlate lab data to obtain PVT and analyze the principles and applications of PVT through experiments
- Distinguish traditional and black oil PVT properties and carryout fluid characterization with EOS
- Perform slim tube simulations and MMP and phase behaviour calculation
- Explain Heptane plus characterization, phase equilibria and equations of state
- Describe gas injection, interfacial tension and list applications in reservoir simulation

Who Should Attend

This course provides an overview of all significant aspects and considerations of fluid properties and phase behavior (PVT) for chemists and reservoir engineers dealing with phase behaviour miscible displacement and reservoir simulation.

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

- A. Nomenclature
- B. Hydrocarbons
- Dry Gas
- Wet Gas
- Crude Oil
- Heavy or Black Oil
- C. PVT Measurements
- Pressure, Volume, Temperature
- Sampling
- Characterization Factor
- Exercise
- Bubblepoint Pressure
- Isothermal Compressibility
- Exercise
- Gas Viscosity
- Correlation Charts
- Calculating Gas Viscosity
- Produced Water Properties
- Resistivity

- Viscosity
- pH
- Redox Potential
- Surface (Interfacial) Tension
- Hydrates
- Produced Water Formation Volume Factor
- Produced Water Density
- Measuring Formation Water Density
- D. Phase Equilibria
- Chemical Potential
- Fugacity
- Raoult's Law
- Non-Ideal Mixing
- Henry's Law
- Course Recap
- A. Equation of State
- Boyle's Law
- Classical Ideal Gas Law
- Cubic Equations of State
- Virial Equation of State
- Acentric Factor
- Soave Modification of Redlich-Kwong
- Peng–Robinson Equation of State
- Multiparameter Equations of State
- Helmholtz Function Form
- Mixing Rules
- B. Thermodynamics
- Enthalpy
- Raoult's Law
- Principle
- Negative Deviation
- Azeotropes
- Hydrogen Bond

- Negative Deviation
- Negative Deviation
- Henry's Law
- Examples
- Carnot Cycle
- Carnot Cycle Stages: Step 1
- Carnot Cycle Stages: Step 2
- Carnot Cycle Stages: Step 3
- Temperature-Entropy Diagram
- Thermodynamic Cycle Based on Carnot Theorem
- The Ideal Carnot Cycle
- Real vs. Ideal
- Rankine Cycle
- Carnot Engine Efficiency
- Equation of State
- Definition
- Uses of EOS
- Benefits of EOS
- Boyle's Law
- Charles's law or Law of Charles and Gay-Lussac
- Dalton's Law of Partial Pressures
- The Ideal Gas Law
- Van der Waals Equation of State
- Redlich-Kwong Equation of State
- Soave Modification of Redlich-Kwong
- Acentric Factor
- Values of **ω** of some Common Gases
- Peng-Robinson Equation of State
- Peng-Robinson-Stryjek-Vera Equations of State
- Elliott, Suresh, Donohue Equation of State
- C. Production Loss and Flow Assurance
- Flow Assurance Issues
- Definition of Corrosion

- How Corrosion Occurs
- Various Forms of Corrosion
- Grouping of Types of Corrosion
- Group I
- Group II
- Group III
- Examples of Corrosion in Group I
- Examples of Corrosion in Groups II, III
- Corrosion Prevention Techniques
- How Can We Slow the Process?
- Monitoring and Maintenance
- Deposition of Solids
- Hydrates
- Glycol Dehydration of Gas
- Wax / Paraffin
- Asphaltenes
- What is Asphaltene?
- Factors Affecting Asphaltene Stability
- Differences between Asphaltene and Wax
- Emulsions
- Scales
- Hydrocarbon Phase Behaviour
- General Hydrocarbon Phase Behaviour
- Concept of Equilibrium
- Phase Behaviour of Fluids
- Phase Behaviour of a Pure Component
- Phase Behaviour of a Pure Fluid (Single Component)
- B. Phase Behaviour Calculations
- Phase Behaviour in Reservoir Simulation
- Representing Phase Behaviour
- Gibbs Phase Rule
- Number of Phases and Phase Type.
- Two-Phase Flash

- Vapor–Liquid Equilibrium
- Gas Dew Point Pressure
- Isochoric Phase Stability Testing
- Compositional Grading
- Factors Leading to Composition Variation
- Difficulties in Modelling Compositional Variation
- Phase Behaviour Calculations
- Equilibrium Assumptions
- Non-Ideal Solution
- C. Fluid Characterisation
- Simple Distillation
- Fractional Distillation
- Gas Chromatography
- Lee–Kesler Method
- Drawdown and Build-Up Mobilities
- Fluid Mobility
- Mobility from Build-Up
- Wireline Sampling Techniques
- Formation Fluid Testers
- Advanced Sampling Techniques
- Pump Out Module Performance
- Controlled Drawdown Sampling
- Charged Chamber Sampling
- Guard Probe or Focused Sampling
- Wireline Testing
- Fluid Sampling
- Consideration for Sample Collection
- Single Phase Sampling
- Development Well Testing
- Production Well Testing
- Alternative to Downhole Gauges
- Reservoir Pressure
- Steady State Radial Flow

- Course Recap
- Production Manifold
- Production Manifold
- Laminar Flow
- Laminar Flow
- Laminar and Turbulent Velocity Profile
- Two Phase Flow (Gas-Liquid)
- Two Phase Flow – Horizontal
- Two Phase Flow – Vertical
- Two Phase Flow - Liquid Slugging
- Process Separators
- Surface Petroleum Operations
- Gas Production – Alternatives
- Classification of Separators
- Gravity Separators
- Multistage Separation
- Centrifugal Separators
- Recycling Separator
- Cyclone Separators
- Separators – Internals
- Filter Separators
- Twister Supersonic Separator
- Slug Catchers
- Double-Barrel Horizontal Separator (also suitable as Slug Catcher)
- Test Separator
- Horizontal Test Separator
- Gas-Oil Separation Principles
- Separation Processes
- Separator - Pressure Control
- Sand Production
- End of this Section
- Dehydration Processes
- Need for Dehydration

- Need for Gas Dehydration
- Methods of Dehydration
- Refrigeration
- Mechanical Refrigeration
- Self-Refrigeration
- A**b**sorption
- A**b**sorption: Liquid desiccant dehydration
- Troubleshooting
- A**d**sorption: Solid Desiccant Dehydration
- Adsorption
- Dehydration By Membrane Permeation
- End of this Section
- Water & Gas Injection Technology
- Introduction
- Water Injection
- Gas Injection
- Process Troubleshooting
- Introduction
- Production Facilities
- Corrosion
- Emulsion Treating
- Scale Formation
- Naturally Occurring Radioactive Material (NORM)
- Water Disposal
- Hydrogen Sulfide
- Phase Separators
- Gas Hydrates
- Leak Detection in Pipelines
- End of this Section