COURSE OVERVIEW DE0507
Basic Processing
(E-Learning Module)

Course Title
Basic Processing (E-Learning Module)

Course Reference
DE0507

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 basic overview of processing. It covers the processing flow, the sequence of events, data processing and processing sequence; the geometry definition, static corrections, amplitude recovery, velocity filtering, deconvolution, CMP gather, demultiple, NMO correction, DMO correction, CMP stack and migration; the pre stack migration (2D marine), 3D and 2D processing sequence; the generalized 2D land processing flow chart, 2D post-stack depth migration flow chart, generalized 3D land processing flow chart, 3D post-stack depth migration flow chart and generalized 3D marine processing flow chart; the Snell's reflection law, the seismic selection and seismic data processing; and the data after geometry applied, trace editing and attenuation.

During this course, participants will learn the weathering and evaluation of statics and datum plane statics; the deconvolution and F-k filtering; the seismic trace, common mid point gather and NMO curves; the velocity analysis, processing sequence, dynamic corrections and bandpass filtering; the bidirectional reflector, types of multiples, interbed and intrabed multiples and characteristics of multiples; the wavefront impinging upon a dipping reflector, the use of wavefront chart in conjunction with a simple reflection model; the common tangent to the wavefronts and a more realistic approach; and the basic theory covering geometrical approach and theorical approach.

Course Objectives

After completing the course, the employee will be able to:-

- Apply and gain a comprehensive knowledge on basic processing
- Describe processing flow, the sequence of events, data processing and processing sequence
- Discuss geometry definition, static corrections, amplitude recovery, velocity filtering, deconvolution, CMP gather, demultiple, NMO correction, DMO correction, CMP stack and migration
- Employ pre stack migration (2D marine) as well as illustrate 3D and 2D processing sequence
- Describe generalized 2D land processing flow chart, 2D post-stack depth migration flow chart, generalized 3D land processing flow chart, 3D post-stack depth migration flow chart and generalized 3D marine processing flow chart
- Discuss Snell's reflection law and apply seismic selection and seismic data processing
- Review data after geometry applied and carryout trace editing and attenuation
- Evaluate weather statics and datum plane statics as well as employ deconvolution and F-k filtering
- Discuss the seismic trace, common midpoint gathering and NMO curves
- Employ velocity analysis, processing sequence, dynamic corrections and bandpass filtering
- Identify the bidirectional reflector, types of multiples, interbed and intrabed multiples and characteristics of multiples
- Determine wavefront impinging upon a dipping reflector and use wavefront chart in conjunction with a simple reflection model
- Recognize the common tangent to the wavefronts and apply a more realistic approach
- Discuss the basic theory covering geometrical approach and theorical approach

Who Should Attend

This course provides an overview of all significant aspects and considerations of basic processing for entry or junior level geophysicists and more experienced staff who interpret seismic data and need exposure to acquisition and processing techniques.

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

- Processing Flow
- Data Processing Overview
- The Sequence of Events
- Data Processing - In the beginning….
- Data Processing - What next?
- Why Reformat?
- Data Processing - raw shot data
- Processing Sequence
- Geometry definition - Where are the shots and receivers located ?
- Static corrections - What if the surface elevation changes ?
- Amplitude recovery - Where's all the source energy gone ?
- Velocity filtering - How to remove coherent noise?
- Deconvolution - How to improve the vertical resolution?
- CMP gather - How to order the data?
- Demultiple - How to remove false reflections?
- NMO correction - How to correct for time differences due to offset within the CMP?
- DMO Correction - Do the reflections all come from a single point?
- CMP stack - How to reduce the number of traces?
- Migration - Do the reflections all come from vertically below?

- Pre Stack migration (2D marine)
- Processing Sequence (3D marine)
- Processing Sequence (2D land)
- Generalized 2D Land Processing Flow Chart
- 2D Post-Stack Depth Migration Flow Chart
- Generalized 3D Land Processing Flow Chart
- 3D Post-Stack Depth Migration Flow Chart
- Generalized 3D Marine Processing Flow Chart
- Process Overview
- Snell's Reflection Law
- Midpoint
- The Seismic Selection
- Objectives of Seismic Data Processing
- Accuracy and Resolution
- Extraction of Subsurface Properties – Amplitudes
- Extraction of Subsurface Properties – Velocities
- Extraction of Subsurface Properties – Frequencies
- Processing Sequence – Reformating/Geometry
- Processing Sequence – Pre Processing
- Processing Sequence – NMO/Satck
- Processing Sequence – Advanced Processing
- Data-Trace-Header
- SPS Information to Update Header Words
- DATA after Geometry Applied
- Trace Editing
- Attenuation
- Amplitude Decay/Recovery Curves
- Weathering and Evaluation Statics, Datum Plane Statics
- Deconvolution
- What is the Wavelet?
- The Seismic Trace (without decon)
- F-k Filtering
- Common Mid Point (cmp) Gather

- NMO Curves
- Velocity Analysis
- Processing Sequence – Velocity Picking
- Dynamic Corrections
- Mute – After CDP Gather and NMO
- Muting Effect
- CMP Stack (after NMO and Mute)
- Processing Sequence – Brut Stack
- Bandpass Filtering
- Multiples – The Bidirectional Reflector
- Multiples – Types of Multiples
- Multiples – Interbed and Intrabed Multiples
- Multiples – Multiple Recognition - Summary
- Multiples – Characteristics of Multiples
- Multiples – Attenuation
- Residual Statics – Horizon Picking on Stack
- Processing Sequence – Residual Statics
- Migration – Introduction
- Non Zero Offset Section
- Zero Offset Section
- Migration – Zero Offset
- Zero offset trace plotted in time
- Many traces show the reflector position
- Migration – Effect of Dip
- Prestack
- Post-Stack
- Migration – Wavefront Migration
- Considering a wavefront impinging upon a dipping reflector
- Method
- Use Wavefront Chart in Conjunction with a simple reflection model
- The Common Tangent to the wavefronts is the true position of the reflector
- A more realistic approach is to assume velocity increases with depth which gives this

- DIP moveout
- Basic theory-Geometrical approach Theorical approach
- Basic Geometry
- Reflection point smearing
- Conventional stack ignores reflection point
- This leads to smearing of the dipping reflection events
- Stacking velocity is dip dependent
- Dip versus velocity
- Dip moveout Geometry
- Dip moveout Basics
- 2D Dip Moveout Impulse Response
- With a Dipping Reflector
- Overlaying the input and outputs
- 3D Dip Moveout Impulse Response
- Section through the clliptical bowl
- General DMO Sequence
- Input Data (Offset Planes)
- Standard Seismic Processing & Data Flow
- Geovecteur modules
- Summary
- Migration – Introduction
- Zero offset
- Is Dip Relevant?
- Effect of Dip
- Prestack
- Post-stack
- Limitations
- Wavefront Migration
- The common tangent to the wavefronts is the true position of the reflector
- The more realistic approach is to assume velocity increases with depth which gives this wavefront chacteristic
- Diffraction Curve
- Wavefronts and Diffraction Curves

- Migration – Methods
- Kirchhoff Summation Migration
- Finite Difference Migration
- Frequency / Wavenumber (f-k) Migration
- Processing of Reflection data
- Processing of reflection data
- Result of processing of data
- Basic scheme of the seismic data processing Demultiplexing
- Demultiplexing
- Dataformats
- SEGY-Format
- Editing
- Geometry
- Raypaths for a given bin
- Static
- Surface consistent statics
- Static Corrections
- Muting of events
- Migration/imaging
- Overview
- Basic Scheme of the seismic data processing
- Migration-a definition
- Aim of migration
- Geometrical distortion
- Point scatterer
- Migration/Imaging Algorithm
- Wavefront charting
- Migration of individual reflections back to position of point scatterer
- Wavefront charting
- Dipping layer
- Syncline (valley)
- Structural model of the subsurface
- Stacked section without migration

- Anticline and Syncline
- Migration unties the bowtie and turns them into synclines below A and B
- Over and Under migration
- Undermigrated data
- Overmigrated data
- Methods for (post-stack) Migration
- Diffraction migration using Huygens' secondary sources
- Diffraction migration
- FK migration
- Muting of Events
- Wave equation migration
- Edge effects
- Lateral velocity variation? Depth migration
- Image rays
- Depth migration
- Migration types
- Three-dimensional versus
- Types of migration cheap/expensive
- Post -/Pre-stack Time/Depth migration
- Subsurface model used in seismic processing
- Post Stack Depth Migration
- Pre Stack Depth Migration
- Optimising the Acquisition & Processing of 3D Seismic Data
- 3D Acquisition Ray Paths and Reflection Points
- Factors Affecting Amplitudes
- Initial Processing - Amplitude Recovery
- Attenuation Compensation
- Attenuation
- VSP Amplitude Spectrum Versus Depth
- Impact of Q on Processing
- Statics
- Static Corrections
- First Pass Statics Versus Residual Statics

- Pre-Stack Time Migration
- Effect of Dip on Velocity
- The Effect of Dip at Non-Zero Offset
- Failure of Time Migration
- Time and Depth Migration (constant velocity)
- Depth Migration Myths & Truths
- Anisotropy
- Vertical Transverse Isotropy (VTI)
- VTI Affects Seismic to Well Ties
- Parameterizing VTI Anisotropy
- 4th Order Moveout
- Gathers after Detailed Velocity Analysis
- Gathers after Anisotropic Velocity Analysis
- Optimising the Acquisition & Processing of 3D Seismic Data
- Vertical Resolution – Reminder
- Wedge Model Seismic Response
- Time-Amplitude Analysis of a Wedge Model
- Vertical Resolution – Summary
- Maximising Vertical Resolution in Acquisition
- Vertical Resolution – Example
- Spectra
- DMO/Post-Stack Migration
- DMO/Post-Stack Migration with HFI
- Horizontal Resolution
- Seismic Energy Reflects from a Patch, not a Point
- Unmigrated Data and Diffractions
- Migration Collapses Diffractions
- Aperture and Horizontal Resolution
- Migration Collapses Diffractions, Improves Resolution
- Maximising Horizontal Resolution
- Reminder - 3D Acquisition Coverage
- Basic Processing
- Seismic data processing

- Introduction and theoretical background
- Seismic Reflection & Refraction Basics
- Seismic waves
- Wave propagation concepts
- The particles in the medium do not travel with the wave
- Wave elements
- Classification of Seismic Waves
- Types of waves
- P and S Waves
- Ray Paths
- Multiple Reflections
- Types of Multiples
- Ghost Reflections
- Attenuation of Seismic Waves
- Seismic Velocities
- Stress and Strain
- Elastic Moduli
- Estimating Seismic Velocities
- Factors affecting seismic velocity
- Reflection coefficient
- Frequency Concepts
- Linear Filters
- Convolution
- Fourier analysis
- Filters in the frequency domain
- Phase
- Cross Correlation
- Auto-correlation
- Frequency Aliasing
- Seismic Resolution
- Improving Vertical Resolution
- Horizontal Resolution
- Improving Horizontal Resolution

- Seismic Data Processing
- Introduction
- Generalized Processing Flow
- Demultiplexing
- Gain recovery
- Equalization and AGC
- Equalization
- Automatic Gain Control (AGC)
- Trace Editing
- Polarity
- Resampling
- Trace Muting
- Trace Muting (front end)
- Trace Muting (Surgical)
- Seismic Data Processing II
- Static Correction
- Introduction
- Topographic Variations
- Weathered layer
- Near Surface Irregularities
- Computation of Datum Static Corrections
- Marine Datum Static Correction
- Uphole Recording
- Refraction Surveys
- First breaks
- Tomotography
- Residual Statics
- Replacement Statics
- Tidal Statics
- Seismic Data Processing III
- Deconvolution
- Signature Deconvolution
- Frequency Domain Signature Deconvolution

- Time Domain Signature Deconvolution
- Vibroseis Correlation
- Signature Deconvolution Example
- FX Deconvolution
- Statistical Deconvolution
- Deconvolution Parameters
- Deconvolution Examples
- Seismic Data processing IV
- Filtering
- F/K Filtering
- Linear tau-P filtering
- Frequency Filtering
- Seismic Data Processing V
- Sorting, Gathering, & Dynamic Corrections
- Sorting & Gathering
- Common Offset
- Common Shot
- Dynamic Correction
- Picking Velocity
- Non-Hyperbolic Moveout
- NMO Stretching
- Velocity Quality Control
- Dip Moveout (DMO)
- Seismic Data Processing VI
- Noise and Multiple Attenuation
- Type of Noises
- Multiple Attenuation
- Velocity Discrimination
- F/K Multiple Attenuation
- T-P Multiple Attenuation (T-P Deconvolution)
- RADON Multiple Attenuation
- General Overview of Multiple Suppression Methods
- Multiple Attenuation Example

- Seismic Data Processing VII
- Stacking, Migration and Depth Conversion
- CMP Stacking
- Migration and Depth Conversion
- Seismic Data Migration
- Migration Effects and Techniques
- Time Migration
- Depth Migration
- Migration Stage
- F-K Migration
- Phase Shift Migration
- Finite-Difference Migration
- Kirchhoff Migration
- Wave Equation Migration
- Migration Aperture