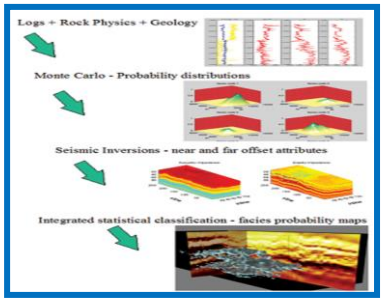
COURSE OVERVIEW DE0609-4D
Rock Physics & Petro Physics for Seismic Interpretation

Course Title
Rock Physics & Petro Physics for Seismic Interpretation



Course Reference
DE0609-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	March 04-07, 2024	Club B, Ramada Plaza By Wyndham Istanbul City Center, Istanbul, Turkey
2	June 10-13, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
3	September 02-05, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
4	December 09-12, 2024	Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

Rock Physics is a key component in oil and gas exploration, development and production. It combines concepts and principles from geology, geophysics, petrophysics, applied mathematics and other disciplines. Rock physics provides the empirical relationships, understanding and theory to connect petrophysical, geomechanical and seismic data to the intrinsic properties of rocks, such as mineralogy, porosity, pore shapes, pore fluids, pore pressures, stresses and overall architecture, such as laminations and fractures.

Rock physics is needed to optimize all imaging and reservoir characterization solutions based on geophysical data, and to such data to build mechanical earth models for solving geomechanical problems. An in depth understanding of rock and fluid physics is crucial for any successful seismic attribute interpretation as well as substantially reducing drilling risk. Seismic petrophysics aims to quantitatively link rock properties with reservoir petrophysical properties. This knowledge then allows for careful attribute screening and the creation of rock physics models properly calibrated to local/regional well data, which could then be used to forward model the seismic response. In order to construct geologically realistic rock physics models, the rock physicist needs to be able to identify and correct anomalous and/or missing data from a petrophysical wireline analysis.

This course is designed for participants to understand the sensitivity of elastic waves in the earth to mineralogy, porosity, pore shapes, pore fluids, pore pressures, stresses, and the anisotropy of the rock fabric resulting from the depositional and stress history of the rock, and how to use this understanding in quantitative interpretation of seismic data and in the construction of mechanical earth models.

The course will provide a basic understanding of the relations between elastic and reservoir properties of rocks and demonstrate how rock physics is used to interpret and analyze seismic data. A variety of applications and real data examples is presented. Various rock physics models will be covered and the validity of these models to particular geological scenarios will be discussed.

Course Objectives

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

- Apply and gain an in-depth knowledge on rock physics and petro physics for seismic interpretation
- Discuss rock physics, hooke's law, anisotropy and elastic wave velocities as well as sedimentary rocks as heterogeneous media
- Describe the concept of the representative elementary volume (REV), elastic properties, voigt/reuss and hashin-shtrikman bounds, modulus-porosity relations for clean sands, critical porosity, mechanical percolation, gassmann's equations and fluid substitution
- Explain fluid properties and mixtures, digenetic and sorting trends in velocity-porosity data, velocity-porosity models for shaly sands, empirical relations between velocity and porosity, clay content, properties of sand-clay mixtures and velocity-porosity relations for shales
- Differentiate the relations between VP and VS rock compressibilities, the relation of 4d seismic to well testing, reflection coefficients and AVO, elastic impedence and rock physics templates
- Identify the effective medium and effective field theories, velocity-porosity relations for carbonates, biot theory, patchy saturation, squirt flow, sediment compaction and the state of stress in the earth
- Recognize pore pressure and the concept of effective stress, poroelasticity, application to pore prediction pressure, fracture gradient, 3D stress modeling, effect of stress on seismic body waves and third-order elasticity
- Carryout granular media and discrete element methods as well as displacement discontinuity methods
- Discuss stress sensitivity of sandstones and shales, determination of velocity variations around a borehole from advanced sonic logging, application to wellbore stability, reservoir geomechanics and stress effects in 4D seismic monitoring
- Explain fractured reservoirs, hydraulic fracture propagation in presence of natural fractures, seismic characterization of fractured reservoirs, modeling the response of a fractured reservoir, rock physics models for fractures, shales and unconventional reservoirs
- Determine anisotropy of shales, rock physics modeling of kerogen in organic-rich shales, effect of anisotropy on AVO and microseismic and the effect of azimuthal anisotropy on propagation of hydraulic fractures

Who Should Attend

This course provides an overview of all significant aspects and considerations of rock physics and petro physics for seismic interpretation for all geoscientists who wish to gain a better understanding and applicability of the rock physics models in the context of diverse geological scenarios.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

Istanbul	**US$ 7,000** per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**US$ 6,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dhabi	**US$ 6,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day
Al Khobar	**US$ 6,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

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

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

Certificates are accredited by the following international accreditation organizations: -

- 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 **2.4 CEUs** (Continuing Education Units) or **24 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 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. Stan Constantino, MSc, BSc, is a **Senior Petroleum Engineer** with over **35 years** of **Offshore & Onshore** experience in **Drilling/Reservoir/Petroleum Engineering** and **Well Service Operations**. His area of expertise includes **Reservoir Surveillance & Management**, **Reservoir Engineering & Simulation**, **Reservoir Monitoring**, **Reservoir Engineering Applications** with ESP and Heavy Oil, **Reserve Evaluation**, **Directional Drilling**, **Drilling Production & Operations**, **Field Development & Production** of **Oil & Gas**, **Wireline Logging**, **Mud Logging**, **Production Logging**, **Slick Line**, **Coil Tubing**, **Exploration Wells Evaluation**, **Horizontal Wells**, **Well Testing**, **Well Workover Supervision**, **Pressure Transient Analysis** and **Petrophysical Log Analysis**. Currently, he is the **Managing Director** of **Geotech** wherein he is responsible in managing the services and providing technical support to underground energy related projects concerning **field development**, **production**, **drilling**, **reservoir engineering** and **simulation**.

Throughout his long career life, Mr. Stan has worked for many international companies such as the **Kavala Oil**, **North Aegean Petroleum Company** and **Texaco Inc.**, as the **Managing Director**, **Operations Manager**, **Petroleum Engineering & Exploration Department Head**, **Assistant Chief Petroleum Engineer**, **Senior Petroleum Engineer** and **Petroleum Engineer**.

Mr. Stan has a **Master's** degree in **Petroleum Engineering** and a **Bachelor's** degree in **Geology** from the **New Mexico Institute of Mining & Technology** and from the **Aristotelian University**, **Greece**, respectively. Further, he is a member of the Society of Petroleum Engineers, USA (**SPE**), Society of Well Log Professional Analysts, USA (**SPWLA**) and European Association of Petroleum Geoscientists & Engineers (**EAGE**).

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 – 0930	***Introduction to Rock Physics*** *What is Rock Physics? ● Rock Physics & Petrophysics ● What's the Difference?*
0930 – 0945	*Break*

0945 – 1015	***Hooke's Law, Anisotropy & Elastic Wave Velocities***
1015 – 1030	***Sedimentary Rocks as Heterogeneous Media***
1030 – 1100	***The Concept of the Representative Elementary Volume (REV) & Effective Elastic Properties***
1100 – 1130	***Voigt/Reuss & Hashin-Shtrikman Bounds***
1130 – 1200	***Modulus-Porosity Relations for Clean Sands***
1200 – 1215	*Break*
1215 – 1230	***Critical Porosity & Mechanical Percolation***
1230 – 1245	***Gassmann's Equations & Fluid Substitution***
1245 – 1300	***Fluid Properties & Mixtures***
1300 – 1315	***Digenetic & Sorting Trends in Velocity-Porosity Data***
1315 – 1345	***Velocity-Porosity Models for Shaly Sands***
1345 – 1420	***Empirical Relations Between Velocity & Porosity, Clay Content, etc.***
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0800	***Properties of Sand-Clay Mixtures***
0800 – 0830	***Velocity-Porosity Relations for Shales***
0830 – 0900	***Relations Between VP & VS***
0900 – 0930	***Rock Compressibilities & Relation of 4D Seismic to Well Testing***
0930 – 0945	*Break*
0945 – 1015	***Reflection Coefficients & AVO***
1015 – 1030	***Elastic Impedence***
1030 – 1045	***Rock Physics Templates***
1045 – 1100	***Effective Medium & Effective Field Theories***
1100 – 1115	***Velocity-Porosity Relations for Carbonates***
1115 – 1130	***Biot Theory***
1130 – 1200	***Patchy Saturation***
1200 – 1215	*Break*
1215 – 1300	***Squirt Flow***
1300 – 1330	***Sediment Compaction & the State of Stress in the Earth***
1330 – 1420	***Pore Pressure & the Concept of Effective Stress***
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0800	***Poroelasticity***
0800 – 0830	***Application to Pore Prediction Pressure***
0830 – 0900	***Fracture Gradient & 3D Stress Modeling***
0900 – 0930	***Effect of Stress on Seismic Body Waves***
0930 – 0945	*Break*
0945 – 1015	***Third-Order Elasticity***
1015 – 1030	***Granular Media & Discrete Element Methods***
1030 – 1100	***Displacement Discontinuity Methods***
1100 – 1130	***Stress Sensitivity of Sandstones***
1130 – 1200	***Stress Sensitivity of Shales***
1200 – 1215	*Break*
1215 – 1300	***Stress Perturbations Around a Borehole***

1300 – 1350	***Determination of Velocity Variations around a Borehole from Advanced Sonic Logging***
1350 – 1400	***Recap***
1400	*Lunch & End of Day Three*

Day 4

0730 – 0800	***Application to Wellbore Stability***
0800 – 0830	***Reservoir Geomechanics & Stress Effects in 4D Seismic Monitoring***
0830 – 0900	***Fractured Reservoirs***
0900 – 0930	***Hydraulic Fracture Propagation in Presence of Natural Fractures***
0930 – 0945	*Break*
0945 – 1015	***Seismic Characterization of Fractured Reservoirs***
1015 – 1030	***Modeling the Response of a Fractured Reservoir***
1030 – 1100	***Rock Physics Models for Fractures***
1100 – 1130	***Shales & Unconventional Reservoirs***
1130 – 1200	***Anisotropy of Shales***
1200 – 1215	*Break*
1215 – 1245	***Rock Physics Modeling of Kerogen in Organic- Rich Shales***
1245 – 1315	***Effect of Anisotropy on AVO***
1315 – 1345	***Microseismic & Effect of Azimuthal Anisotropy on Propagation of Hydraulic Fractures***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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