COURSE OVERVIEW DE0535
Advanced Nodal Analysis for Production Engineers

Course Title
Advanced Nodal Analysis for Production Engineers

Course Date/Venue
Please see page 3

Course Reference
DE0535

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

This course is designed to provide participants with a detailed and Advanced overview of Nodal Analysis. It covers the prediction of rate at which a well should be capable of producing, given reservoir and fluid properties, wellbore configuration, and flowing wellhead pressure; identifying which components of the reservoir/completion/wellbore system are restricting performance; analyzing production data to find permeability, skin factor, and drainage area; and forecasting future performance from historical production trends and from known reservoir properties.

Further, the course will also discuss the components of a nodal analysis system and its applications in oil and gas production; the inflow performance relationships (IPR) for oil wells, gas wells, horizontal and multilateral wells, fractured wells, gas lift and artificial lift systems; the partial penetration effects and deviated wellbore effects; the fracture conductivity and dimensionless productivity index; the IPR for finite and infinite conductivity fractures and impact of fracture damage on well performance; the gravel pack and sand control completion effects, perforation density and phasing; the skin factor due to perforation damage; and optimizing perforation for maximum productivity.

Moreover, the course covers the impact of tubing size on well performance, pressure losses in completion strings and optimizing completion design for nodal analysis; the production data analysis, rate transient analysis (RTA) and pressure transient analysis (PTA); the production forecasting techniques, material balance analysis and data integration with nodal analysis; and the fundamentals of decline curve analysis (DCA) for unconventional reservoirs.

During this interactive course, participants will learn the extrapolating decline curves for future performance, estimating ultimate recovery (EUR) and sensitivity analysis for future performance; the advanced DCA techniques, integration of DCA with nodal analysis and economic analysis and decision making; the nodal analysis for multiphase flow, gas condensate wells, water injection wells and complex well architectures; and the real-time data acquisition and analysis and continuous well performance optimization.

Course Objectives

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

- Apply and gain an advanced knowledge on nodal analysis
- Explain IPR relationships for oil and gas wells and identify the effect of completion issues (partial penetration, deviated wellbore, fracture stimulated well and gravel packs) upon IPR curves
- Apply production data analysis techniques as well as decline curve analysis and future performance estimations
- Discuss the components of a nodal analysis system and its applications in oil and gas production
- Explain the inflow performance relationships (IPR) for oil wells, gas wells, horizontal and multilateral wells, fractured wells, gas lift and artificial lift systems
- Describe partial penetration effects and deviated wellbore effects
- Discuss fracture conductivity and dimensionless productivity index, IPR for finite and infinite conductivity fractures and impact of fracture damage on well performance
- Recognize gravel pack and sand control completion effects, perforation density and phasing, skin factor due to perforation damage and optimizing perforation for maximum productivity
- Implement the impact of tubing size on well performance, pressure losses in completion strings and optimizing completion design for nodal analysis
- Carryout production data analysis, rate transient analysis (RTA) and pressure transient analysis (PTA)
- Employ production forecasting techniques, material balance analysis and data integration with nodal analysis
- Discuss the fundamentals of decline curve analysis (DCA) for unconventional reservoirs
- Describe extrapolating decline curves for future performance, estimating ultimate recovery (EUR) and sensitivity analysis for future performance

- Apply advanced DCA techniques, integration of DCA with nodal analysis and economic analysis and decision making
- Carryout nodal analysis for multiphase flow, gas condensate wells, water injection wells and complex well architectures
- Apply real-time data acquisition and analysis and continuous well performance optimization

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course covers systematic techniques and methodologies on advanced nodal analysis for production, operations and reservoir engineers, senior technicians and field supervisors with an engineering background.

Course Date/Venue

Session(s)	Date	Venue
1	May 04-08, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE
2	July 14-18, 2025	Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
3	September 21-25, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE
4	November 10-14, 2025	Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

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

US$ 8,000 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

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: -

- 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.

- 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 **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.

Accommodation

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

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. Konstantin Zorbalas,MSc, BSc, is a **Senior Petroleum Engineer & Well Completions Specialist** with **30 years** of **offshore** and **onshore** experience in the **Oil** & **Gas**, **Refinery** & **Petroleum** industries. His wide expertise includes **OIP Estimation & Range** of **Uncertainty**, **Waterflood** Management, **Water Flooding**, **Water Flooding & Reservoir** Sourcing Issues, **Water Flooding**, **Reservoir** Souring & Water Breakthrough, **Well & Reservoir Management** and Monitoring, **Fishing Operations**, **Drilling & Work-Over Operations**, **Workover Best Practices**, Well Testing, Completion Design & Operation, Well Stimulation and **Workover**, **Well Stimulation & Workover** Planning, **Well Completion**, **Servicing & Work-Over** Operations, **Completions & Workover**, HSE in **Work-Over & Drilling** Operations, **Well Testing Completion & Workover**, Basic **Drilling**, **Completion & Workover** Operations, Advanced **Drilling**, **Completion & Workovers Fluids**, **Cementing** Integrity Evaluation, **Cementing** Design, **Cement** Integrity Assurance & Evaluation, Basic **Cementing** (Operations) & Basic Acidizing, **Advanced** Cementing Technology, **Casing & Cementing, Advanced** Cementing & Stimulation, **Artificial Lift** Systems, New Technology in **Artificial Lift Systems**, **Artificial Lift** Methods, **Crude Oil Artificial Lift** Operations, **Artificial Lift** Systems, **Artificial Lift** & Challenges, **Artificial Lift** Systems & Optimization Technology, Production Optimization with **Artificial Lift** System, **Well Integrity & Artificial Lift**, **Formation Damage** & Flow Assurance Issues, **Formation Damage** Evaluation, Prevention, Remediation & Control, **Formation Damage** (Causes, Prevention & Remediation), **Well Completion** Design & Operations, Crude **Oil Market**, Oil **Reserves**, Global Oil **Supply & Demand**, Government Legislation & Oil **Contractual** Agreements, Oil **Projects & Their Feasibility** (Revenue and Profitability), Oil & Gas **Exploration** and **Methods**, Oil & Gas **Extraction**, Oil **Production & Refining**, Technology Usage in Industrial Security; **Oil & Gas Economics** Modelling Evaluation Decision Making & Risk Analysis, **Economic Evaluation** & Global Profitability Criteria, **Petroleum Economics**, Fluid Properties & Phase Behaviour (**PVT**), **Workovers & Completions**, Acidizing Application in **Sandstone & Carbonate**, **Well Testing** Analysis, **Reserves** Evaluation, **Reservoir** Fluid Properties, **Reservoir** Monitoring, **Heavy Oil** Technology, Applied **Water Technology**, **X-mas Tree & Wellhead** Operations & Testing, **Artificial Lift** Systems (**Gas Lift**, **ESP**, and **Rod Pumping**), **Well Cementing**, **Well Completion** Design, **Slickline** Operations, **Cased Hole Logging** and **Production Logging**. Further, he is actively involved in **Project Management** with special emphasis in production technology and field optimization, performing conceptual studies, economic analysis with risk assessment and field development planning. He is currently the **Senior Petroleum Engineer & Consultant** of **Abu Dhabi National Oil Company** (**ADNOC**) Group of companies wherein he is involved in the mega-mature fields in the Arabian Gulf, predominantly carbonate reservoirs; designing the acid stimulation treatments with post-drilling rigless operations; utilizing CT with tractors and DTS systems; and he is responsible for gas production and preparing for reservoir engineering and simulation studies, well testing activities, field and reservoir monitoring, production logging and optimization and well completion design.

During his career life, Mr. Zorbalas worked as a **Senior Production Engineer**, **Well Completion Specialist**, **Production Manager**, **Project Manager**, **Technical Manager**, **Trainer**, **Technical Supervisor** & **Contracts Manager**, **Production Engineer**, **Production Supervisor**, **Production Technologist**, **Technical Specialist**, **Business Development Analyst**, **Field Production Engineer** and **Field Engineer**. He worked for many **world-class oil/gas companies** such as **ZADCO**, **ADMA-OPCO**, **Oilfield International Ltd**, **Burlington Resources** (later acquired by **Conoco Phillips**), **MOBIL E&P**, **Saudi Aramco**, **Pluspetrol E&P SA**, **Wintershall**, **Taylor Energy**, **Schlumberger**, **Rowan Drilling** and **Yukos EP** where he was in-charge of the **design and technical analysis** of a gas plant with capacity **1.8 billion m3/yr gas**. His achievements include **boosting oil production 17.2% per year** since 1999 using **ESP** and **Gas Lift systems**.

Mr. Zorbalas has **Master**'**s** and **Bachelor**'**s** degrees in **Petroleum Engineering** from the **Mississippi State University**, **USA**. Further, he is an **SPE Certified Petroleum Engineer**, **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), an active member of the Society of Petroleum Engineers (**SPE**) and has numerous scientific and technical publications and delivered innumerable training courses, seminars and workshops worldwide.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop 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 Nodal Analysis*** *Definition & Purpose of Nodal Analysis • Components of a Nodal Analysis System • Applications in Oil & Gas Production • Workflow for Performing Nodal Analysis*
0900 – 0930	***Inflow Performance Relationships (IPR) for Oil Wells*** *Darcy's Law & Vogel's IPR Equation • IPR for Undersaturated & Saturated Reservoirs • Multi-Phase Flow Considerations • Case Studies: IPR Curves for Oil Wells*
0930 – 0945	*Break*
0945– 1130	***Inflow Performance Relationships (IPR) for Gas Wells*** *Backpressure Equation & Pseudo-Steady-State Flow • IPR for Dry Gas & Gas Condensate Wells • Non-Darcy Flow Effects • Case Studies: IPR Curves for Gas Wells*
1130 – 1215	***IPR for Horizontal & Multilateral Wells*** *Flow Regimes in Horizontal Wells • IPR Modeling for Complex Well Geometries • Impact of Reservoir Anisotropy • Practical Examples & Calculations*
1215 – 1230	*Break*
1230 – 1330	***IPR for Fractured Wells*** *Fracture Geometry & Conductivity • IPR Modeling for Hydraulically Fractured Wells • Impact of Fracture Length & Orientation • Case Studies: Fractured Well Performance*
1330 – 1420	***IPR for Gas Lift & Artificial Lift Systems*** *IPR Considerations for Gas Lift Wells • Impact of Artificial Lift on Well Performance • Nodal Analysis for ESP & Rod Pump Systems • Optimization Techniques for Lifted Wells*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0830	***Partial Penetration Effects*** *Skin Factor Due to Partial Penetration • Impact on IPR & Productivity Index • Modeling Techniques for Partially Penetrating Wells • Case Studies: Partial Penetration Scenarios*
0830 – 0930	***Deviated Wellbore Effects*** *Skin Factor in Deviated Wells • Impact of Wellbore Angle on IPR • Flow Convergence in Deviated Wells • Practical Examples & Calculations*
0930 – 0945	*Break*

0945 – 1100	***Fracture Stimulated Well Performance*** *Fracture Conductivity & Dimensionless Productivity Index • IPR for Finite & Infinite Conductivity Fractures • Impact of Fracture Damage on Well Performance • Case Studies: Fracture-Stimulated Well Analysis*
1100 – 1215	***Gravel Pack & Sand Control Completion Effects*** *Skin Factor due to Gravel Packs • Impact of Sand Control on IPR • Modeling Gravel Pack Completions • Case Studies: Gravel-Packed Well Performance*
1215 – 1230	*Break*
1230 – 1330	***Perforation Strategy & its Impact on IPR*** *Perforation Density & Phasing • Skin Factor due to Perforation Damage • Optimizing Perforation for Maximum Productivity • Case Studies: Perforation Design Analysis*
1330 – 1420	***Tubing & Completion String Design*** *Impact of Tubing Size on Well Performance • Pressure Losses in Completion Strings • Optimizing Completion Design for Nodal Analysis • Case Studies: Tubing Size Optimization*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0830	***Basics of Production Data Analysis*** *Objectives of Production Data Analysis • Types of Production Data (Rates, Pressures, etc.) • Data Quality Control & Preprocessing • Workflow for Production Data Analysis*
0830 – 0930	***Rate Transient Analysis (RTA)*** *Fundamentals of RTA • Transient, Boundary-Dominated Flow Regimes • RTA for Unconventional Reservoirs • Case Studies: RTA Applications*
0930 – 0945	*Break*
0945 – 1100	***Pressure Transient Analysis (PTA)*** *Fundamentals of PTA • Diagnostic Plots & Interpretation • PTA for Fractured & Horizontal Wells • Case Studies: PTA Applications*
1100 – 1215	***Production Forecasting Techniques*** *Empirical & Analytical Forecasting Methods • Decline Curve Analysis for Forecasting • Uncertainty Analysis in Production Forecasting • Case Studies: Production Forecasting Examples*
1215 – 1230	*Break*
1230 – 1330	***Material Balance Analysis*** *Principles of Material Balance • Applications for Oil & Gas Reservoirs • Combining Material Balance with Nodal Analysis • Case Studies: Material Balance Applications*

1330 – 1420	***Data Integration with Nodal Analysis*** *Integrating Production Data into Nodal Analysis • History Matching & Validation • Real-Time Data Integration for Well Optimization • Case Studies: Integrated Analysis Examples*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

0730 – 0830	***Fundamentals of Decline Curve Analysis (DCA)*** *Types of Decline Curves (Exponential, Hyperbolic, Harmonic) • Arps' Decline Curve Equations • Applications of DCA in Reservoir Engineering •Case Studies: DCA Examples*
0830 – 0930	***DCA for Unconventional Reservoirs*** *Challenges in Unconventional DCA • Modified Hyperbolic Decline Models • DCA for Shale Gas & Tight Oil Wells • Case Studies: Unconventional DCA*
0930 – 0945	*Break*
0945 – 1100	***Future Performance Estimation*** *Extrapolating Decline Curves for Future Performance • Estimating Ultimate Recovery (EUR) • Sensitivity Analysis for Future Performance • Case Studies: Future Performance Estimation*
1100 – 1215	***Advanced DCA Techniques*** *Type Curve Analysis • Machine Learning Applications in DCA • Probabilistic Decline Curve Analysis • Case Studies: Advanced DCA Applications*
1215 – 1230	*Break*
1230 – 1330	***Integration of DCA with Nodal Analysis*** *Combining DCA with Nodal Analysis for Well Optimization • Forecasting Well Performance Under Different Scenarios • Case Studies: Integrated DCA & Nodal Analysis*
1330 – 1420	***Economic Analysis & Decision Making*** *Economic Indicators (NPV, IRR) • Using Nodal Analysis & DCA for Economic Decisions • Case Studies: Economic Analysis Examples*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

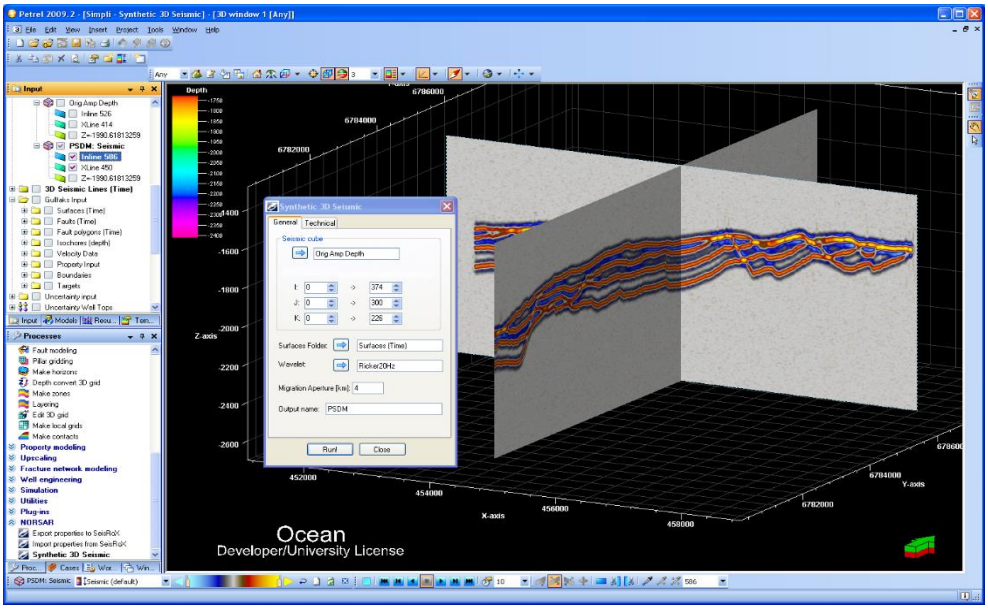
Day 5

0730 – 0830	***Nodal Analysis for Multiphase Flow*** *Multiphase Flow Correlations (Hagedorn-Brown, Beggs-Brill) • Impact of Multiphase Flow on Nodal Analysis • Case Studies: Multiphase Flow Analysis*
0830 – 0930	***Nodal Analysis for Gas Condensate Wells*** *Flow Behavior in Gas Condensate Reservoirs • Impact of Condensate Banking on IPR • Case Studies: Gas Condensate Well Analysis*
0930 – 0945	*Break*

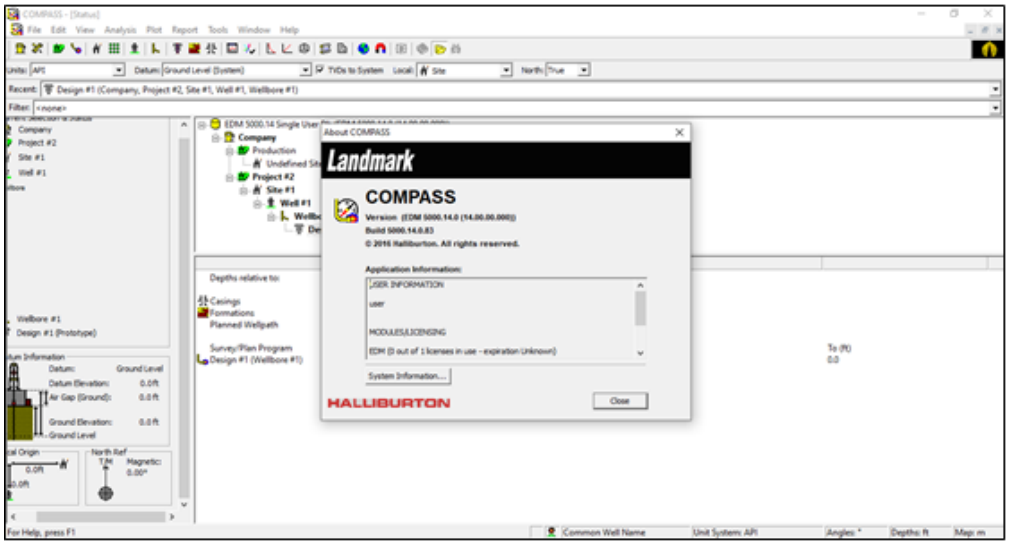
0945 – 1100	***Nodal Analysis for Water Injection Wells*** *IPR for Water Injection Wells • Impact of Injection Pressure on Well Performance • Case Studies: Water Injection Well Analysis*
1100 – 1215	***Nodal Analysis for Complex Well Architectures*** *Smart Wells & Intelligent Completions • Nodal Analysis for Multilateral Wells • Case Studies: Complex Well Analysis*
1215 – 1230	*Break*
1230 - 1400	***Real-Time Monitoring & Optimization*** *Real-Time Data Acquisition & Analysis • Continuous Well Performance Optimization • Case Studies: Real-Time Optimization Examples*
1400 – 1415	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1415 – 1430	***POST-TEST***
1430	*Lunch & End of Course*

Simulator (Hands-on Practical Sessions)

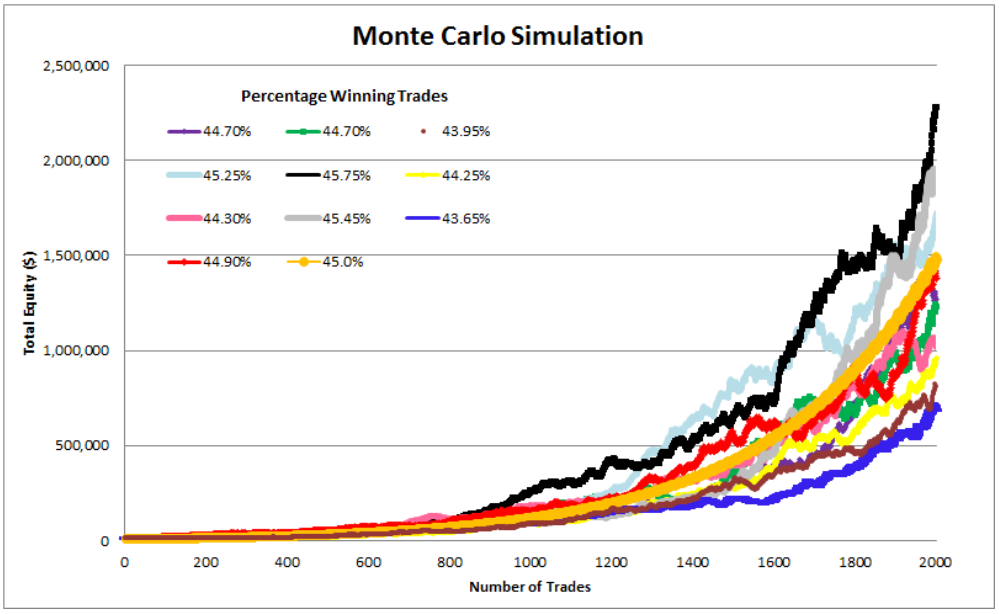
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the "Petrel Software", "COMPASS", "Monte Carlo", "KAPPA", "Interactive Petrophysics (IP)", "ECRIN", "PIPESIM", "Eclipse Software" and "PROSPER" software's.



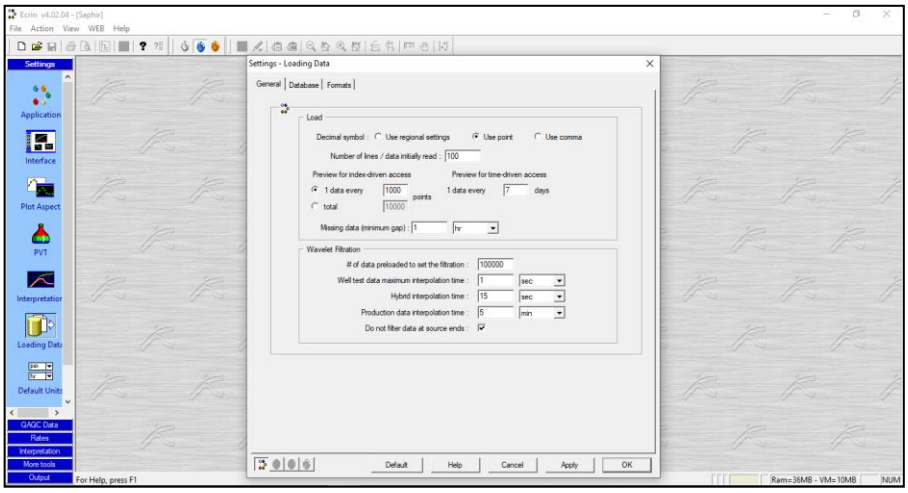
Petrel Software



COMPASS



Monte Carlo Simulation



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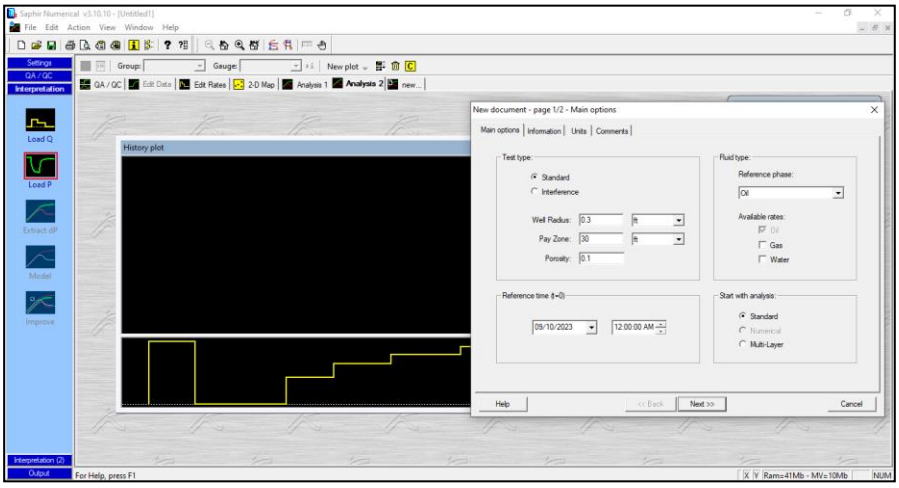

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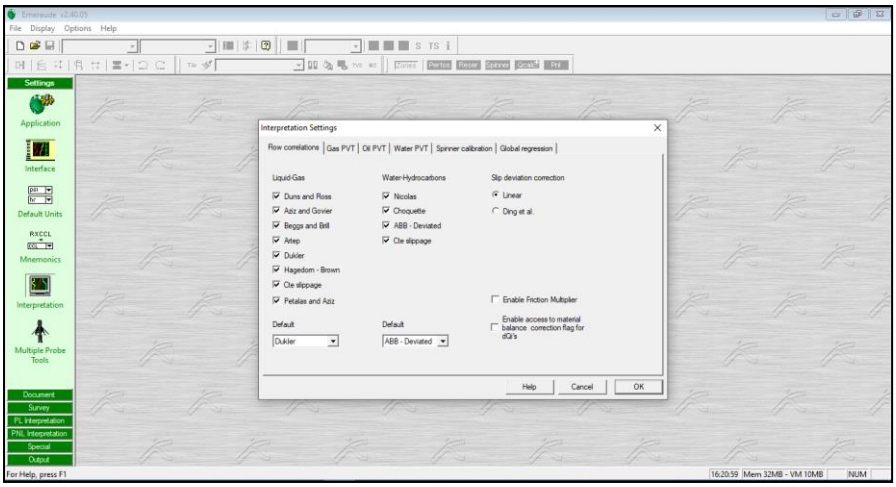

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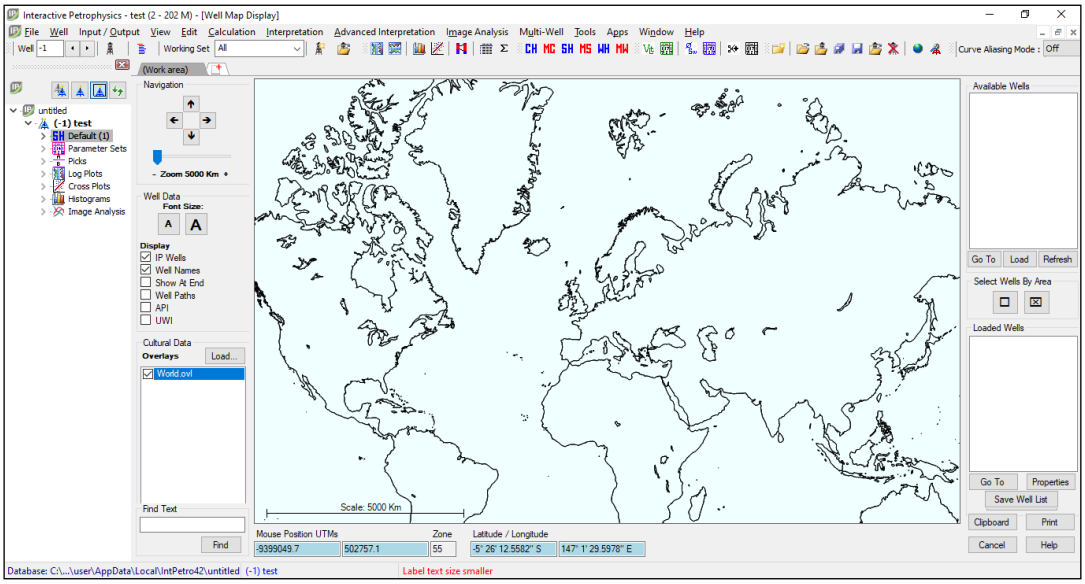
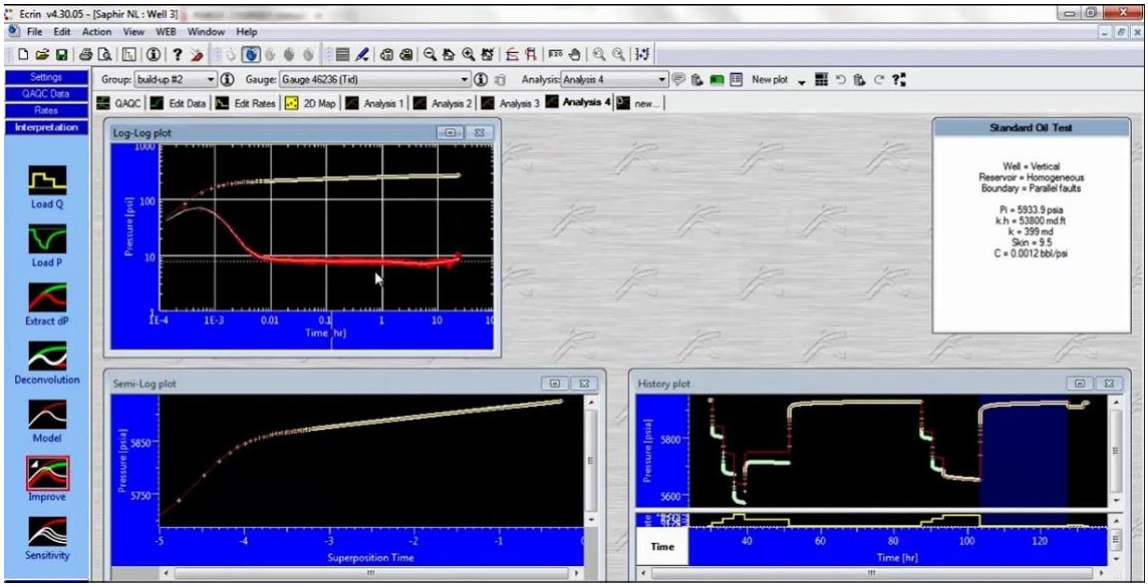
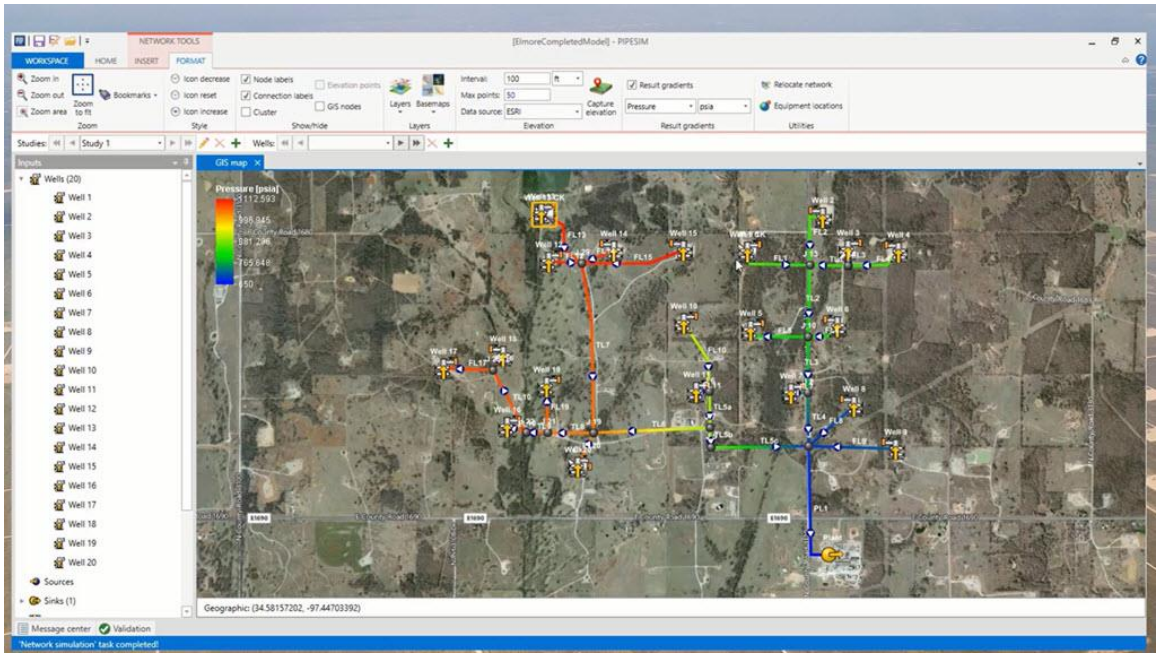


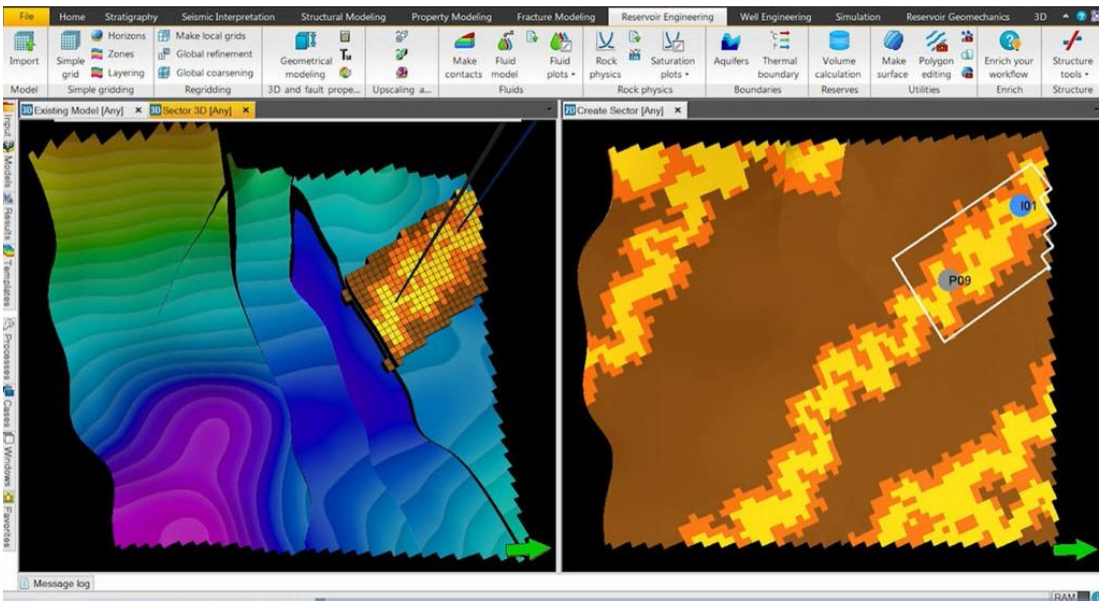
Interactive Petrophysics (IP) Software



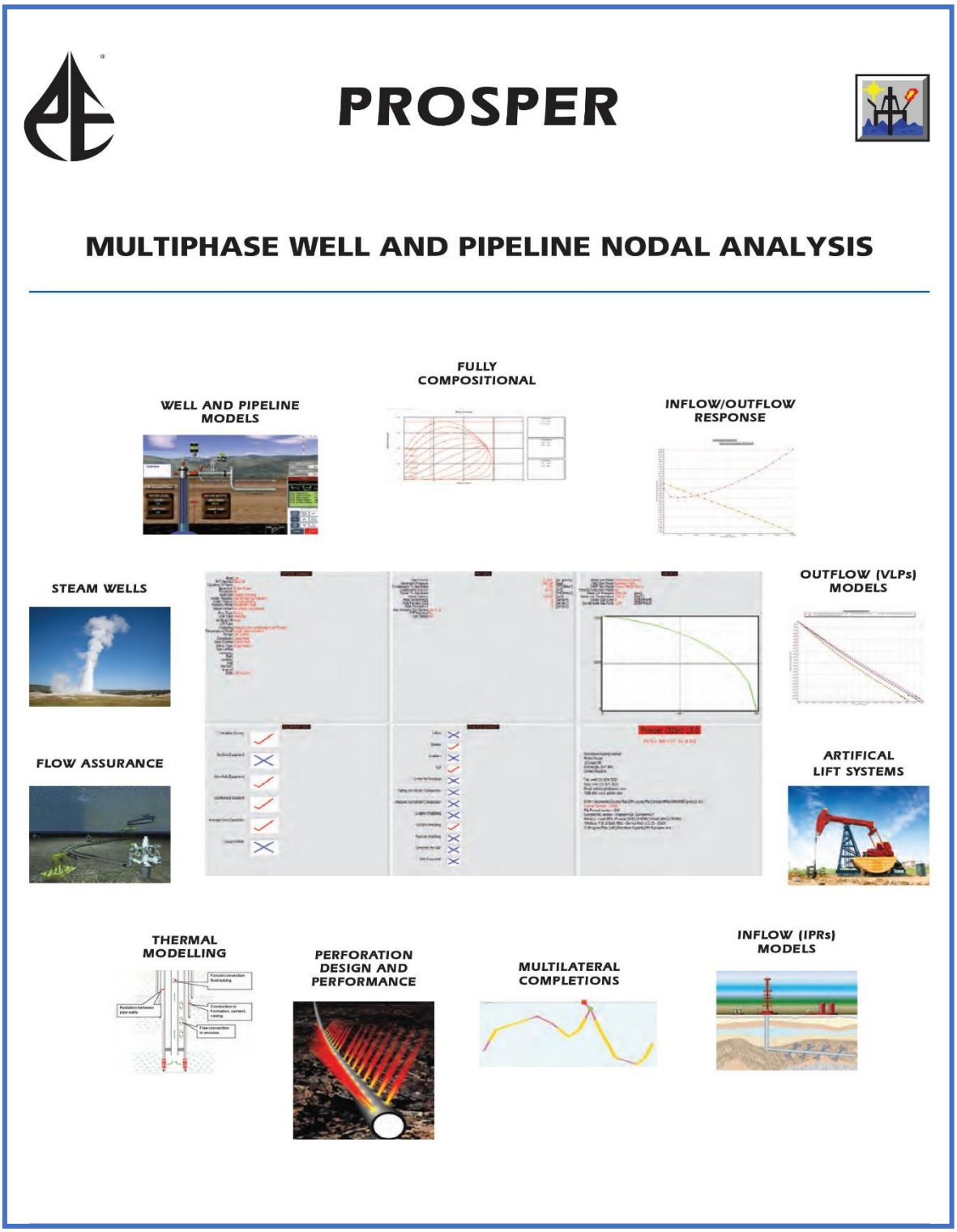
ECRIN Software



PIPESIM



Eclipse Software



Course Coordinator
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