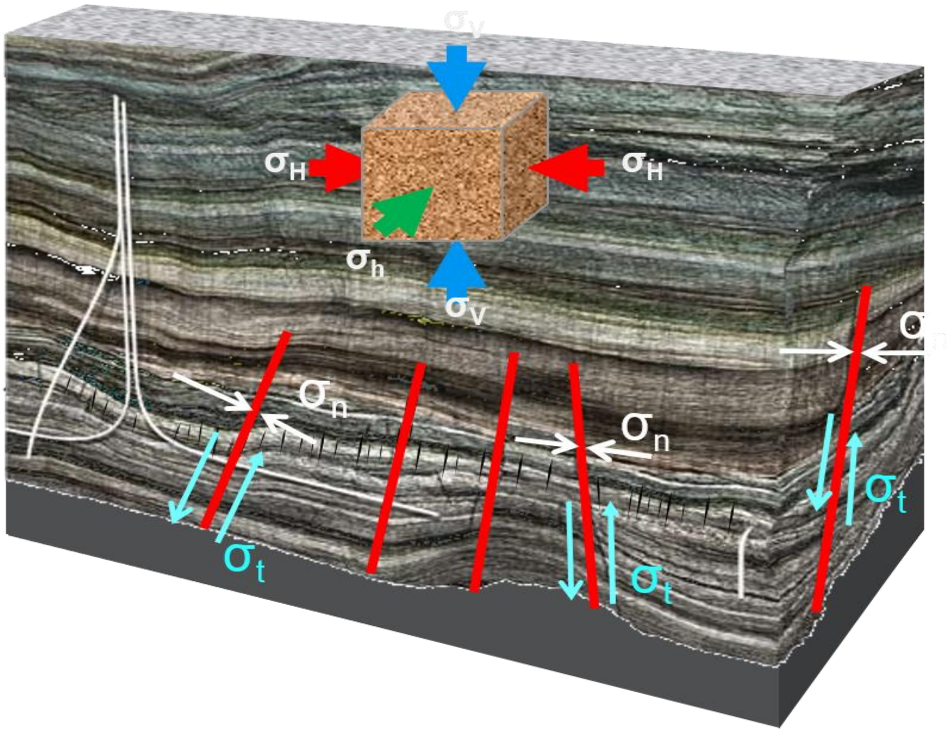
GEONAFT
zyfra group

Geomechanics advanced course



Course type	Online-course based Microsoft Teams or Skype
Duration	24 hours
Number of participants	A group of 15 attendee
Language	English
Participants	Hydraulic fracturing and geomechanics specialists, drilling and completions engineers, geologists and production engineers
Knowledge level	Advanced
Technology requirements	Laptop for tests and practical tasks execution, Core-i5 and 8Gb RAM and above
Software	Geonaft (license will be provided)

Course description

This course covers the basic principles and practical aspects of geomechanical modelling for wide range of tasks in purpose of drilling and completion, stimulation and fracturing, hydrocarbon production and field development planning:

- The main stages and elements of the initial information analysis, determination of preliminary cause-and-effect relationships and potential limitations in the process of geomechanical modeling;
- Methods of missing data recovery and calibration information evaluation, preliminary estimates of the stress state;
- Understanding the origin of stresses in the geological settings and how well logs and measurements can help in assessing the in-situ stress conditions;
- Determination of mechanical facies and calculation of elastic-strength parameters, calibration with mechanical core test results;
- Overburden stress calculation and overpressure prediction, reservoir depletion modeling. Calibration of the estimated stress profile against downhole measurements, well tests and indirect information;
- Calculation of the stress state, calibration of the minimum horizontal stress profile, evaluation of the stress regime and magnitude of the maximum horizontal stress. Preparing the basis for hydraulic fracturing designs, wellbore stability assessment and bottom-hole pressures optimization during operation;
- Wellbore instability problems, methods for calculation and forecast on planned trajectory, uncertainties evaluation. Recommendations for ECD limits during drilling and completion

The course is designed in such a way that, after theoretical part, the students could implement gained knowledge in practice when building Geomechanical Earth Model for purposes and tasks arising at different stages of oilfield lifecycle. The emphasis is on calculation of static elastic and strength properties, pressures and stresses, analyzing wellbore stability and sensitivity to input parameters, forecasting of safe mud window for a planned well trajectory using specialized software Geonaft.

Proposed course also includes an introductory part on reservoir geomechanics. The influence of field development (changes in in pressure and temperatures) on the stress state will be considered, which in turn can lead to undesirable effects and risks in drilling and completion of wells, formation stimulation (fracturing, injection and flooding), production decline and to early water breaking through. Basic principles and practice on static geomecanical 3D model building in GeoTensor software.

GEONAFT
zyfra group

Short program course “Practical aspects of geomechanics modeling for drilling optimization, exploration and production”

Form of study: distance learning using Microsoft Teams or Skype online platforms

№ п/п	Types of Training	Total hours
1.	Total training hours	24
2.	Lectures	12
3.	Practical tasks, tests	12

Curriculum-thematic plan

№ темы	Name of sections, disciplines and topics	Total hours	Lecture hours	Practice hours
	Day 1 – Introduction to the Geomechanics Modeling Process			
1.	The generalized process of creating a Geomechanical Model along wells (1D) and in space (3D - 4D), its application at different stages of the field’s life cycle.	2	1.5	0.5
2.	Analysis of initial information, understanding of problems, goals and objectives. Work with key data, assumptions and analysis of potential calculation uncertainties.	2	2	-
3.	Collection of calibration information according to core data, according to the results of drilling and construction, hydraulic fracturing and well development, their operation.	2	2	-
	Day 2 – Practical lesson, review of Geonaft software			
4.	Analysis of tabular data, reports and the formation of calibration statistics	2	-	2
5.	Review of the functionality of the Geonaft software for solving problems in the field of geomechanical modeling	2	2	-
6.	Formation of the project: loading data and calibration information, setting up templates, data visualization.	2	-	2
	Day 3 – Practical lesson with application of Geonaft software, 1D modeling			
7.	Calculation of rock pressure and forecast AMP.	3	1	2
8.	Determination of mechanical facies, calculation of elastic-strength properties, stress state assessment	3	0.5	2.5
	Day 4 – Practical lesson with application of Geonaft software, introduction to 3D modeling			
9.	Calculation of well stability. Calibration of the model on the results of research, measurements, comparison with drilling events.	2	0.5	1.5
10.	Transferring calculations from a reference well to a planned profile, forecasting a safe drilling window and preparing recommendations.	2	0.5	1.5
11.	Fundamentals of 3D geological and geomechanical modeling and practical application of the results for production and development tasks.	2	2	-
	Total:	24	12	12

GEONAFT
zyfra group

Geomechanics Input Data Requirements

The following tables give a list of all input data useful for fit to purpose geomechanics study. Since not all data are usually available a data audit at the beginning of the project is recommended to assess the quality and usefulness of the available input data:

Offset well (existing wells) data for geomechanics pre-drill study / post–drill WBS evaluation

	No.	Item	Must have	Better to have	Nice to have
Field scale	1	Field layout	⍰		
	2	Full field review report		⍰	
	3	Field development plan		⍰	
Reservoir	4	Reservoir pressure	⍰		
	5	Well test data (e.g. DST)		⍰	
Geology	6	Geological report	⍰		
	7	Geological cross-section		⍰	
	8	Image log interpretation report	⍰		
	9	Formation tops	⍰		
	10	Stratigraphic column		⍰	
	11	Structural map	⍰		
	12	Geology related papers			⍰
Drilling	13	Daily drilling report	⍰		
	14	Strip log / master log / mud logging data	⍰		
	15	Deviation Survey	⍰		
	16	Stress measurements (XLOT, LOT, MDT, RFT)	⍰		
	17	Casing and cementing diagram	⍰		
	18	Real-time drilling data (ECD, ROP, Hook load, Pump rate, Pump pressure, Torque)		⍰	
	19	Cavings, Cutting reports, pictures		⍰	
Log data	20	Sonic data: DSI (DTCO, DTSM), MSIP for unconventional	⍰		
	21	Image log data (FMI, FMS, SHDT, UBI, OBMI)	⍰		
	22	Openhole logs (GR, NPHI, RHOB, CALI, DT, Resistivity)	⍰		
	23	Elan volumes		⍰	
Core	24	Core data (UCS, Friction angle, Poisson ratio, Young's modulus, porosity, density, petrography)		⍰	
Seismic	25	Cross line section		⍰	
	26	Inline section		⍰	
Stimulation	27	Operation report		⍰	
	28	Measured breakdown pressures and closure pressures		⍰	
	29	Final report		⍰	
Production	30	Well sketch and completion design		⍰	
	31	Production history (incl. drawdown, reservoir pressure)		⍰	
	32	Workover history		⍰	
	33	Sand production history		⍰	
Planned Wells	34	Proposed trajectory	⍰		
	35	Formation tops	⍰		
	36	In line/Cross line seismic sections		⍰	

Planned well (additional items if MEM and WBS are to be extrapolated to a planned well trajectory):

	No.	Item	Must have	Better to Have	Nice to have
Geology	1	Expected formation tops	X		
Drilling	2	Planned well trajectory	X		
Seismic	3	Seismic interval velocities at planned well location		X	
	4	Seismic cross-section		X	

Single Well 3D Geomechanical and Hydraulic Fracturing Modelling

№	Item	Must have	Better to have	Nice to have
1	3D Geological model (3D grids and properties, stratigraphy, structural map, formations tops, faults, fractures).	X		
2	1D Mechanical Earth Model (MEM) from offset wells	X		
3	Open hole logs (GR, NPHI, RHOB, CALI, DTCO, DTSM, Resistivity)	X		
4	MSIP data (Sonic Scanner), FMI, UBI, borehole imaging.	X		
5	ELAN volumes or analogues		X	
6	Geomechanical core data (UCS, friction angle, Poisson's ratio, Young's modulus, porosity, density)		X	
7	Core test data (permeability, porosity, pore throat, etc.)			X
8	Daily Drilling Report	X		
9	In-situ formation tests – stresses (XLOT, LOT, MDT)		X	
10	Reservoir Pressure	X		
11	Well test data		X	
12	Completion advisor (Pumping schedule, Perforations, Fluids)	X		
13	DataFrac		X	
14	HF monitoring (microseismic, rad. tracers, temperature logs, etc.)		X	
15	Well construction, production and pressure history		X	