Applied Geophysics

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Module number	Credits	Workload	Semester[s]	Duration	Group size
SE-CO-12	10 CP	300 h	2. Sem.	1 Semester[s]	no limitation

Courses	Contact hours	Self-study	Frequency
a) Reservoir Geophysics	a) 3 WLH (45 h)	a) 120 h	a) each summer
b) Rock Physics	b) 3 WLH (45 h)	b) 90 h	b) each summer

Module coordinator and lecturer(s)

Prof. Dr. Jörg Renner

a) Prof. Dr. Jörg Renner

b) Prof. Dr. Jörg Renner

Admission requirements

Recommended previous knowledge:

Sound mathematical skills (vector calculus, differential- and integral calculus)

Learning outcome, core skills

After successful completion of the module students

- appreciate the scale-dependent approach to the physical characterization of rocks (micro-to decimeter-scale) and reservoirs (deci- to kilometer-scale)
- understand the relation between physical properties of rocks and their chemical composition and microstructure
- learned the use and limits of empirical and theoretical concepts for the description of heterogeneous media
- know the practical aspects of a suite of methods in exploration geophysics
- are familiar with the mathematical description of physical processes on rock and reservoir scale
- understand the origin of the governing partial differential equations and master some approaches to their solution

Contents

a)

- Introduction to reservoirs (hydrocarbon, geothermal)
- Physical properties of reservoir fluids
- Hydraulic transport (Kozeny-Carman relation) and storage (linear poro-elasticity I: isostatic stress states)
- Theory and practice of pumping tests (diffusion equation, scaling)
- Geothermics (add advection to diffusion)
- Aspects of waves in real media (wave equation, linear poro-elasticity II: add deviatoric stresses)

b)

- Introduction to rocks and minerals
- Porosity and interface phenomena
- Hydraulic transport in rocks (Darcy's law, permeability models)
- Elasticity (stress, strain, Hooke's law, averaging schemes)
- Failure of rocks (fracture and friction)

- Laboratory practical: students independently conduct simple experiments to determine basic physical properties of rocks (density, porosity, permeability, elastic wave velocities, electrical conductivity) and fluids (density, viscosity)

Educational form / Language
a) Lecture (3 WLH) / English
b) Lecture (3 WLH) / English / German

Examination methods
• Written exam 'Applied Geophysics' (180 min., Part of modul grade 100 %, + report on lab experiments)

Requirements for the award of credit points
Passed module exam

Module applicability
- M.Sc. Subsurface Engineering

Weight of the mark for the final score
Percentage of total grade [%] = 10 * 100 * FAK / DIV
FAK: The weighting factors can be taken from the table of contents.
DIV: The values can be taken from the table of contents.

Further Information
Literature: Jaeger, Cook, Zimmerman “Fundamentals of Rock Mechanics”; Gueguen, Palciauskas “Introduction to the physics of rocks“; Schön “Physical properties of rocks“; Mavko, Mukerji, Dvorkin “The rock physics handbook“; AGU reference shelf “Rock physics and phase relations“; Sully “Elements of petroleum geology”; Wang “Theory of linear poro-elasticity”; Fetter “Applied hydrogeology”; Zoback “Reservoir geomechanics”; Carcione “Wave-fields in real media”