PUBLIC CUSTOMIZED TRAINING COURSE ON
Theories and Applications of Geomechanics and Rock Engineering

The **International School for Geoscience Resources** of KIGAM presents an intensive training course on **Theories and Applications of Geomechanics and Rock Engineering**. The course will take place at the Ara room of International School for Geoscience Resources of KIGAM in Daejeon (Korea) in **June 8 to 12, 2015** and will include the following topics.

Topics	Date	Instructor
Day 1. Fundamentals of Geomechanics Topic 1. Why rock mechanics? Topic 2. Rock strength and failure criteria Topic 3. In-situ stress in rock mass Topic 4. Applications in rock engineering	June 8	Seokwon Jeon (Seoul National University, Korea)
Day 2. Reservoir Geomechanics Topic 1. Reactive flow and permeability dynamics Topic 2. Properties of gas shales and coals Topic 3. Hydraulic fracturing for hydrocarbons	June 9	Derek Elsworth (Pennsylvania State University, USA)
Day 3. Computational Geomechanics I Topic 1. Field equations for flow and transport Topic 2. Finite element methods Topic 3. Mass and heat transport in porous media	June 10	
Day 4. Computational Geomechanics II Topic 1. Reactive transport Topic 2. Coupled hydro-mechanical models Topic 3. Boundary element methods	June 11	
Day 5. Properties of Rock and Rock Mass Topic 1. Practice of Laboratory rock tests	June 12 (Morning)	Dae-Sung Cheon (KIGAM, Korea)

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Ministry of Science, ICT and Future Planning

COURSE INFORMATION

Agenda

- This course covers the theories and applications in geomechanics and rock engineering related to oil, mining, and civil industry. The topics include fundamental rock mechanics, reservoir geomechanics, fluid flow in rock mass, rock mass characterization, computational and experimental geomechanics, and other related issues.

Course Covered

- Particpants will understand the basic and core knowelege of geomechanics and rock engineering. This course will cover the fundanmentals of geomechanics and its applications which include failure criteria, in-situ stress, rock mass characteirzation, various lab & field tests etc.
- Participants also will develop an understanding of methods of modeling important physical and chemical phenomena involved in natural and engineered systems. These include both separate and mixed solid (solid mechanics) and fluid (computational fluid mechanics) systems, including reactive components. The emphasis is on finite element methods but also includes other continuum methods including integral methods.

Course Requirements: Prerequisite

- Understanding of basic solid mechanics theories
- Participants should be familiar with algebra and basic calculus.
- Exposure to basic elments of geomechanics and hydrology
- Knowledge of the basic physics of fluid flow and heat transport in porous media
- Understanding of numerical methods for solving partial differential equations
- Experience with Excel will help but is not necessary

Who should Attend?

- This course is mainly designed to train entry and intermediate-level geological engineers, geophysicists, reservoir engineers, civil engineers, and mining engineers who are interested in geomechanics.
- For scientists or engineers involved in reservoir engineering involving geomechanics for CO_2 sequestration, geothermal engineering, hydrocarbon recovery form conventional and unconventional reservoirs and the disposal of radioactive wastes.

Summary of topic contents and learning objectives

Related to the material of the course, the participants will:

- Understand the failure and deformation behaviour of rock
- Know the failure criteria of rock
- Know how to determine the in-situ stresses in rock mass
- Understand how to classify the rock mass based on the properties of the rock and rockmass
- Gain an appreciation of the properties controlling the response of reservoirs.
- Understand the evolution of permeability in reservoirs and the controlling factors.
- Be able to apply modeling methods to problems of fluid flow, heat and mass transport and deformation in porous and fractured media.

Day 1. Fundamentals of Geomechanics

This segment will introduce the fundamentals of geomechanics with the viewpoint of theory and application.

- Introdcution of rock mechanics
- Rock strength and failure criteria
- In-situ stress in rock mass
- Measuring and Interpretation of in-situ stress
- Applications in rock engineering

Day 2. Reservoir Geomechanics

This segment will introduce an understanding of reservoir geomechanics with emphasis on the evolution of fluid transmission response of porous and fractured media.

- Reactive flow and permeability dynamics - THMC
- Properties of gas shales and coals
- Hydraulic fracturing for resource recovery
- Introduction to computational dynamics
- Introduction to fluid flow
- Field equations for fluid flow

- **Day 3. Computational Geomechanics I**

This will build on our initial understanding related to the fluid transmission response of porous and fractured media.

- Finite element methods – 2D elements
- Higher-order elements – 1D elements
- Numerical integration
- Transient fluid flow
- Time integrations for transient response
- Introduction to mass transport
- Mass transport 2D elements

- **Day 4. Computational Geomechanics II**

This will build on our initial understanding related to the fluid transmission response of porous and fractured media including deformation and geomechanics

- Reactive transport 3.3
- Geomechanics and 2D elements
- Dual porosity/dual permeability models
- Hydro-mechanical models – poromechanics
- Linked THM models
- Boundary solution methods I
- Boundary solution methods II

- **Day 5. Properties of Rock and Rock Mass**

This segment will cover the practice of various laboratory rock tests. It also deals with monitoring techniques for safety contructurcion of rock structrues.

- Practice of various rock tests

About the instructor – *Prof. Seokwon Jeon*

Seokwon Jeon is a professor in the Department of Energy Resources Engineering at Seoul National University. His research interests include rock fracture mechanics, fragmentation, blasting and mechanical excavation of rock, and so on.

About the instructor – *Prof. Derek Elsworth*

Derek Elsworth is a professor in the Departments of Energy and Mineral Engineering and of Geosciences and the Center for Geomechanics, Geofluids, and Geohazards. His interests are in the areas of computational mechanics, rock mechanics, and in the mechanical and transport characteristics of fractured rocks, with application to geothermal energy, the deep geological sequestration of radioactive wastes and of CO2, unconventional hydrocarbons including coal-gas, tight-gas-shales and hydrates, and instability and eruption dynamics of volcanoes.

About the instructor – *Dr. Dae-Sung Cheon*

Dae-Sung Cheon is a principal research in Underground Space Departments at Korea Institute of Geoscience and Mineral Resources. His interests are in the areas of geomechanics and rock engineering, and in the laboratory/field tests and safety monitoring and of underground facilities with application to deep underground utilizations.