جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Rock Mechanics for Energy Geo-Engineerin - ERPE 230

Division	Physical Science and Engineering Division
Course Number	ERPE 230
Course Title	Rock Mechanics for Energy Geo-Engineerin
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	04:00 PM - 06:00 PM | Sun Mon

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
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Teaching Assistant(s)

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Course Information

Comprehensive Course Description	Rock formation; tectonism; geological structures and reservoirs. Intact Rock. Fractures: characterization, description joint sets. Fractured rock. Properties. Initial conditions: stress field in the earth crust, fluid composition and pressure. Hydraulics: matrix and fractures; mixed fluids and reactive fluids; evolution of fluid pressure during production. Mechanics: strain hardening and softening, strain localization, tensile and shear failure, creep, constitutive models, yield-envelope. Thermal properties and heat transfer. Classical hydro-mechanical coupling (effective stress, reservoir compaction, deformation, fault reactivation), and multi-HTCM couplings. Well and reservoir engineering: drilling and stimulation in various formations. Challenges: shale instability, sand production, creep. Rock and rock mass characterization - laboratory and field
Course Description from Program Guide	Rock formation; tectonism; geological structures and reservoirs. Fractured rock mass (Fracture characterization, description of fracture sets); intact rock versus fractured rock. Initial conditions: stress field in the earth crust, fluid composition and pressure. Hydraulics: matrix and fractures; mixed fluids and reactive fluids; evolution of fluid pressure during production. Mechanics: strain hardening and softening, strain localization, tensile and shear failure, creep, constitutive models and yield-envelope. Thermal properties and heat transfer. Classical hydro-mechanical coupling (effective stress, reservoir compaction, deformation, fault reactivation), and multi-HTCM couplings. Well and reservoir engineering: drilling and stimulation in various formations. Challenges: shale instability, sand production and creep. Laboratory and field rock and rock mass characterization.
Goals and Objectives	Expertise in rock mechanics and processes with relevance to energy applications
Required Knowledge	Math - Physics - Mechanics
Reference Texts	Assigned papers
Method of evaluation	**40.00**% - Research Project **40.00**% - Tests **20.00**% - Homework /Assignments

Nature of the assignments	Weekly
Course Policies	-This course will be conducted under the guidelines of KAUST's Academic Honor Code. › Cheating of any kind is unethical and unacceptable. -Do not cut and paste any part of your homework or lab reports. › Quote and attribute any words that are not your own. -Wireless communication system of all kinds must be turned off while in the classroom, including cell phones.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/25/2019	Introduction: Rocks and fractured rock mass. Examples: infrastructure and energy geo-engineering
1	Mon 08/26/2019	Mathematics: Algebra, matrices. Vectors and tensors. Complex numbers. Exponential functions. Trigonometry
2	Sun 09/01/2019	Cont. Mechanics: Stress, strain. Effective stress. Principal stresses, Mohr circle. Linear elasticity. Stiffness tensor. Elastic parameters. Superposition
2	Mon 09/02/2019	cont.
3	Sun 09/08/2019	Elasticity: Point loads: Bousinesq & Mindlin. Holes: Kirsch. Superposition (s1, s3, seepage, no leak-off). Wells.
3	Mon 09/09/2019	cont.
4	Sun 09/15/2019	Visco-Elasticity: Rock mass time-dependent response – Reservoirs. Continuum vs. lumped parameter models. Maxwell. Kelvin-Voigt. SDoF. SLS. Complex impedance. Time & frequency domain analyses
4	Mon 09/16/2019	cont.
5	Sun 09/22/2019	University holiday
5	Mon 09/23/2019	Saudi National Day
6	Sun 09/29/2019	Test
6	Mon 09/30/2019	Project - First Draft
7	Sun 10/06/2019	Thermo-Elasticity: Examples (well, nuclear waste, geothermal, CAES). Parameters. Analysis - Superposition
7	Mon 10/07/2019	cont.
8	Sun 10/13/2019	Poro-Elasticity: Effective stress – Various boundary conditions. Biot & Skempton – Parameters. Analyses & predictions
8	Mon 10/14/2019	Cont
9	Sun 10/20/2019	Fractures: Graphical solutions - Stereonets (fracture sets, angles, intersections, instability). Analytical solutions
9	Mon 10/21/2019	cont
10	Sun 10/27/2019	Rock Mass Classification: RQD. Bieniawski's RMR. Barton's Q. Drillability.
10	Mon 10/28/2019	Rock Mass Properties: Strength. Intact and fractured rock. Dilation. Fluid conductivity: blocks & fractures. Dilation. K-tensor. Thermal properties – Conductivity and diffusivity. HT coupling: Heat conduction in advective regime
11	Sun 11/03/2019	cont.
11	Mon 11/04/2019	cont
12	Sun 11/10/2019	Pore pressure: Normal and overpressure. Seals & pressure discontinuities. Pore pressure estimation
12	Mon 11/11/2019	In situ stresses: Normal, strike-slip and reverse faulting (Andersonian classification). Frictional faulting theory. Critically stressed fractured media. Stress polygon. Bilateral constraints and acoustic methods. Optimal well direction - Fault reactivation
13	Sun 11/17/2019	cont
13	Mon 11/18/2019	cont
14	Sun 11/24/2019	Well Logging: Purpose. Tools. Interpretation
14	Mon 11/25/2019	cont
15	Sun 12/01/2019	Closing Topics - Project
15	Mon 12/02/2019	Closing Topics - Project
16	Sun 12/08/2019	Final test
16	Mon 12/09/2019	n/a

Note

The instructor reserves the right to make changes to this syllabus as necessary.