



Module name: Introduction to Rock Mechanics

Academic year: 2019/2020 Code: GIKS-1-809-n ECTS credits: 3

Faculty of: Mining and Geoengineering

Field of study: Environmental Engineering Specialty: —

Study level: First-cycle studies Form and type of study: Part-time studies

Lecture language: English Profile of education: Academic (A) Semester: 8

Course homepage: —

Responsible teacher: dr hab. inż. Jakubowski Jacek (Jacek.Jakubowski@agh.edu.pl)

Module summary

Basic concepts, approaches and methods of Rock Mechanics are presented. Introduction to lab tests, rock mass quality, joint network description, jointed rock mass models.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	Is aware of his/her competencies in the area of Rock Mechanics and paths of their further development.	IKS1A_K01	Execution of exercises, Report, Oral answer, Test, Activity during classes
Skills: he can			
M_U001	Student knows mechanical properties of rock and is capable of performing basic laboratory tests.	IKS1A_U03	Activity during classes, Test, Oral answer, Report, Execution of exercises
M_U002	Student knows joint and joint network attributes, is able to select methods for their description and site investigation.	IKS1A_U03	Execution of exercises, Activity during classes, Test, Oral answer, Report
M_U003	Student understands the difference between the mechanical properties of rock material and rock mass. Can use index properties to perform classification of rock mass and assess its strength and deformability.	IKS1A_U03	Activity during classes, Test, Oral answer, Report, Execution of exercises
Knowledge: he knows and understands			

M_W001	Student knows basic concepts and methods of Rock Mechanics.	IKS1A_W05	Activity during classes, Test, Oral answer, Report, Execution of exercises
M_W002	Student can apply the basics of elasticity theory for rock mechanics and understands the assumptions and deficiencies of this approach.	IKS1A_W05	Activity during classes, Test, Oral answer, Report, Execution of exercises

Number of hours for each form of classes

Suma	Form of classes										
	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
15	9	0	6	0	0	0	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	Is aware of his/her competencies in the area of Rock Mechanics and paths of their further development.	+	-	+	-	-	-	-	-	-	-	-
Skills: he can												
M_U001	Student knows mechanical properties of rock and is capable of performing basic laboratory tests.	+	-	+	-	-	-	-	-	-	-	-
M_U002	Student knows joint and joint network attributes, is able to select methods for their description and site investigation.	+	-	+	-	-	-	-	-	-	-	-
M_U003	Student understands the difference between the mechanical properties of rock material and rock mass. Can use index properties to perform classification of rock mass and assess its strength and deformability.	+	-	+	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												

M_W001	Student knows basic concepts and methods of Rock Mechanics.	+	-	+	-	-	-	-	-	-	-	-
M_W002	Student can apply the basics of elasticity theory for rock mechanics and understands the assumptions and deficiencies of this approach.	+	-	+	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	15 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	25 h
Realization of independently performed tasks	35 h
Summary student workload	75 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

Rock Mechanics: problems, key concepts and approaches, fields of application. An overview of Rock Mechanics methods (laboratory tests, in-situ measurements and site investigations, theoretical, empirical, physical and numerical models). Stress tensor and elements of the linear elasticity theory. Failure criteria. Initial stresses in rock mass: theory, measurements and implications. Stress around underground openings. Joint and joint network attributes. Site investigation, data collection and visualization. Mechanical models of joints. Mechanical models of jointed rock mass. Engineering rock mass classifications. Strength and deformability of rock mass. Basic concepts of the block theory for rock slopes and underground openings.

Laboratory classes

Mechanical properties of rock material and their laboratory testing. Uniaxial compression test, stress, strain, strength. Splitting tensile strength. Sonic velocity and dynamic moduli. Creep. Complete stress-strain curve. Three-axial compression test, yield, brittle vs. ductile behavior. Dilatancy and brittle failure precursory phenomena.

Teaching methods and techniques:

Lectures: Treści prezentowane na wykładzie są przekazywane w formie prezentacji multimedialnej w połączeniu z klasycznym wykładem tablicowym wzbogaconymi o pokazy odnoszące się do prezentowanych zagadnień.

Laboratory classes: W trakcie zajęć laboratoryjnych studenci samodzielnie rozwiązują zadany problem praktyczny, dobierając odpowiednie narzędzia. Prowadzący stymuluje grupę do refleksji nad problemem, tak by otrzymane wyniki miały wysoką wartość merytoryczną.

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

A pass may be obtained at the primary date or at one resit date. Participation in lectures is advised. Participation in all the laboratory experiments and the reports defense is imperative. The final test includes the range of material from the lectures and classes. Temporary policy and exceptions will be presented at the first lecture. Special circumstances of obtaining a pass will be presented by the tutors at the beginning of term.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:

- Attendance is mandatory: No

- Participation rules in classes: Studenci uczestniczą w zajęciach poznając kolejne treści nauczania zgodnie z sylabusem przedmiotu. Studenci winni na bieżąco zadawać pytania i wyjaśniać wątpliwości. Rejestracja audiowizualna wykładu wymaga zgody prowadzącego.

Laboratory classes:

- Attendance is mandatory: Yes

- Participation rules in classes: Studenci wykonują ćwiczenia laboratoryjne zgodnie z materiałami udostępnionymi przez prowadzącego. Student jest zobowiązany do przygotowania się w przedmiocie wykonywanego ćwiczenia, co może zostać zweryfikowane kolokwium w formie ustnej lub pisemnej. Zaliczenie zajęć odbywa się na podstawie zaprezentowania rozwiązania postawionego problemu. Zaliczenie modułu jest możliwe po zaliczeniu wszystkich zajęć laboratoryjnych.

Method of calculating the final grade

assignments (50%), final test (50%)

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Justified absences at classes may be made up with a different group providing the material implemented at the classes is the same.

Prerequisites and additional requirements

Basic Geology, Strength of Materials (or equivalent introduction to elasticity)

Recommended literature and teaching resources

Goodman R.E. Introduction to Rock Mechanics; Thiel K. Rock mechanics in hydroengineering; Goodman R., Shi G-H. The Block Theory and its Application to Rock Engineering; Hoek E. Practical Rock Engineering; Mogi K. Experimental Rock Mechanics; Hoek E., Bray J. Rock Slope Engineering; Eberhardt E. Rock Engineering, Practice and Design; Bieniawski Z. Engineering rock mass classifications; Brady B., Brown E. Rock mechanics for underground mining;

Scientific publications of module course instructors related to the topic of the module

1. Rock ledge support design : a deterministic and stochastic approach / J. JAKUBOWSKI, J. B. Stypulkowski // W: Eurock 2013: rock mechanics for resources, energy and environment : Wrocław, September 23-26, 2013 / eds. Marek Kwaśniewski, Dariusz Łydźba. —London : CRC Press, Taylor & Francis Group, cop. 2013. — 1 dysk optyczny. — e-ISBN: 978-1-138-00080-3. — S. 813-818. — Bibliogr. s. 818..

2. Top of rock investigations for secant piles at the Bronx shaft / J. JAKUBOWSKI, J. B. Stypulkowski // W: Underground infrastructure of Urban Areas 2 / eds. Cezary Madryas, Beata Nienartowicz, Arkadiusz Szot. — Boca Raton [etc.] : CRC Press/ Balkema, cop. 2012 + CD-ROM. — ISBN: 978-0-415-68394-4. — S. 55-66. — Bibliogr. s. 66

3. Statistical simulation of 3D blocky structure - a guide for tunnel design in jointed rock / J. JAKUBOWSKI // W: Rock mechanics : a challenge for society : proceedings of the ISRM regional symposium : EUROCK 2001 : Espoo Finland 4-7 June 2001 / eds. P. Särkkä, P. Eloranta. — Lisse [et al.] : A. A. Balkema, 2001. — S. 351-355. — Bibliogr. s. 355.

Additional information

A pass may be obtained at the primary date or at one resit date. If a student misses over 20% of the classes they may not obtain a pass and may not be permitted to write the resit test. Presence at lectures is advised and may be rewarded. Presence at the classes is compulsory. In order to pass the laboratory classes, participation in all the term's experiments and the reports defense is imperative. Justified absences at classes may be made up with a different group given an agreement is made with both tutors and providing the material implemented at the classes is the same. The final test includes the range of material from all the lectures and classes. Admission to the final test is subject to obtaining a pass in auditory and/or laboratory workshops. Temporary policy and exceptions will be presented at the first lecture. Special circumstances of obtaining a pass will be presented by the tutors at the beginning of term.