UNSW Course Outline

MINE5010 Fundamentals of Rock Behaviour for Underground Mining - 2024

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General Course Information

Course Code : MINE5010
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Minerals & Energy Resources Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course is an introduction to mining rock mechanics and the rock mechanics context within

new and operating underground mines. The course will address the basic physical principles applied to rock mechanics and geotechnical engineering in an underground mining environment; elasticity and stress; rock properties and methods of determination; rock response to load; failure modes; time-dependency; stiffness; energy release; rock mass characterisation; geological environment and structure; stress environment and methods of determination; hydro-geological environment and soft rock/soil mechanics considerations.

Course Aims

This course aims to equip the student with knowledge and skills to design and select appropriate geomechanics techniques for different mining applications.

Upon completion of the course the student should

- Understand the basic mechanical properties of rock and how these are applied to analyse problems in mining geomechanics.
- Have a sound working knowledge of fundamental mechanisms and geotechnical principles within the context of practical coal mining applications;
- Recognise the role and importance of these principles in a comprehensive range of coal mining applications both from a technical perspective, and from the risk and operational management perspective.
- Have a broad knowledge of key numerical methods used in mining rock mechanics

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Describe mining rock mechanics within mining context and geological environments
CLO2 : Apply the principles of rock mechanics and geotechnical engineering
CLO3 : Apply the principles of elasticity and stress; rock properties and methods; rock mass failure modes; as well as behaviour of rock under loading.
CLO4 : Conduct geotechnical laboratory testing (e.g., UCS, triaxial etc) and interpret test results

Course Learning Outcomes	Assessment Item
CLO1 : Describe mining rock mechanics within mining context and geological environments	• Laboratory Assignment • Quizzes • In-Class Team based Assignment
CLO2 : Apply the principles of rock mechanics and geotechnical engineering	• Geology Assignment • Quizzes • In-Class Team based Assignment
CLO3 : Apply the principles of elasticity and stress; rock properties and methods; rock mass failure modes; as well as behaviour of rock under loading.	• Quizzes • In-Class Team based Assignment
CLO4 : Conduct geotechnical laboratory testing (e.g., UCS, triaxial etc) and interpret test results	• Laboratory Assignment • Quizzes • In-Class Team based Assignment

Learning and Teaching Technologies

Moodle - Learning Management System

Additional Course Information

Welcome to MINE5010 Fundamentals of Rock Behaviour.

This course is designed to introduce engineers and geologists to the major geomechanics components associated with mining operations, from resource evaluation and mine design to daily operations. It is, therefore, ideally suited to open cut and underground geotechnical engineers or geologists who have an understanding and experience in the mining industry but are seeking to develop more specialist skills in the geomechanics field. The course content will include the following components:

• Fundamental of rock mechanics

• Intact rock characterisation
• Discontinuities characterisation and modelling
• Rock mass classification
• Fundamental of coal geology
• Mine Design issues
• Ground control management and environmental geomechanics.

The course is structured to provide an initial overview of basic principles and terminology plus the major geomechanical properties and behavioural characteristics of rock material.

An important component will be an emphasis on the interdependencies between geotechnical parameters and mine design/operational decisions and requirements. The link between geological and engineering disciplines is an important component in successfully managing these dependencies.

This course assumes a student has knowledge of

- as this is a technical course in a postgraduate program, a fundamental understanding of both Mathematics and Physics to a standard at least equivalent to a first year course in a university engineering program
- basic mining and geological terms and descriptions
- mining systems.

Total student effort hours: Approximately 150 hours

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Laboratory Assignment Assessment Format: Individual	35%	
Geology Assignment Assessment Format: Individual	35%	
Quizzes Assessment Format: Individual	15%	
In-Class Team based Assignment Assessment Format: Group	15%	

Assessment Details

Laboratory Assignment

Assessment Overview

Rock testing laboratory report will be assessed using a marking rubrics which will be provided on the course moodle site. Feedback will be provided via moodle or online.

Course Learning Outcomes

- CLO1 : Describe mining rock mechanics within mining context and geological environments
- CLO4 : Conduct geotechnical laboratory testing (e.g., UCS, triaxial etc) and interpret test results

Geology Assignment

Assessment Overview

Assess overall understanding of students on basic coal geology and will be assessed using a marking rubrics which will be provided on the course moodle site. Feedback will be provided via moodle or online.

Course Learning Outcomes

- CLO2 : Apply the principles of rock mechanics and geotechnical engineering

Quizzes

Assessment Overview

Basic questions on the course content to asses overall understanding of students. Feedback will be provided via moodle or online.

Course Learning Outcomes

- CLO1 : Describe mining rock mechanics within mining context and geological environments
- CLO2 : Apply the principles of rock mechanics and geotechnical engineering
- CLO3 : Apply the principles of elasticity and stress; rock properties and methods; rock mass failure modes; as well as behaviour of rock under loading.
- CLO4 : Conduct geotechnical laboratory testing (e.g., UCS, triaxial etc) and interpret test results

In-Class Team based Assignment

Assessment Overview

Geotechnical data collection and interpretation from their mine site - case study. This assessment will be completed in class and feedback provided in class.

Course Learning Outcomes

- CLO1 : Describe mining rock mechanics within mining context and geological environments
- CLO2 : Apply the principles of rock mechanics and geotechnical engineering
- CLO3 : Apply the principles of elasticity and stress; rock properties and methods; rock mass failure modes; as well as behaviour of rock under loading.
- CLO4 : Conduct geotechnical laboratory testing (e.g., UCS, triaxial etc) and interpret test results

General Assessment Information

Specific assessment information will be provided on Moodle

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 2 : 19 February - 25 February	Seminar	Date: 19th February (duration 8 hours) Introduction to the Course and the Fundamentals of Rock Behaviour • Introduction to the program and the course • Minerals and Energy Resources Eng student OHS induction and assessment • Introduction to Moodle/Library Access • Fundamental of Geomechanics • Intact Rock, Discontinuity and Rock Mass Date: 20th February (duration 8 hours) Fundamentals of Rock Behaviour • Intact Rock, Discontinuity and Rock Mass (Cont'd) • Rock mechanics lab inspection/induction • Assignments discussion Date: 21st February (duration 8 hours) Coal Mine Geology • Mine geology investigations • Mine geophysical investigations Date: 22nd February (duration 8 hours) Mine Geology Investigations • Impact of geology on mining – case studies

Attendance Requirements

All students will need to attend the class (face-to-face or online) during the time of the delivery.

Course Resources

Prescribed Resources

- Galvin, JM. (2016). Ground Engineering - Principles and Practices for Underground Coal Mining (Springer).
- Rock Mechanics for Underground Mining GHG Brady & ET Brown, 3rd edition, Kluwer Academic Press, 2004.
- Rock Mechanics and the Design of Structures in Rock. L Obert & WI Duvall, John Wiley & Sons (1967)
- Fundamentals of Rock Mechanics, JC Jaeger & NGW Cook, Chapman & Hall (1979).

- Rock Fracture Mechanics. BN Whittaker, RN Singh & G Sun, Elsevier (1992).
- Coal Mine Ground Control. SS Peng, John Wiley & Sons (1986).
- Geotechnical Instrumentation and Monitoring in Open Pit and Underground Mining. T Szwedzicki (ed.), AA Balkema (1993).
- Rock Support in Mining and Underground Construction. PK Kaiser & DR McCreath (eds.), AA Balkema (1992).
- Rock Slope Engineering. E Hoek & JW Bray, Inst. of Mining & Metallurgy, London (1994).
- Rockbursts in Coal Mines and their Prevention. G Brauner, AA Balkema (1994).
- Australian Coal Mining Practice – Monograph 12. AJ Hargraves, CH Martin (eds.), AusIMM (1975).
- Subsidence Engineers' Handbook. National Coal Board (1975).
- Rock Support and Reinforcement Practice in Mining. E Villaescusa, C Windsor & A Thompson (eds.), AA Balkema (1999).
- Cablebolting in Underground Mines. D Hutchinson & M Diederichs, BiTech Publishers (1996).
- Diederichs, M., Lato, M., Hammah, R., Quinn, P. 2007. Shear Strength Reduction (SSR) approach for slope stability analyses. Proceedings of the 1st Canada-US Rock Mechanics Symposium, Vancouver. pp. 319-327.
- Duncan, J., Wright, S. 2005. Soil Strength and Slope Stability, John Wiley & Sons Inc.
- Harrison, J., Hudson, J. 2000. Engineering Rock Mechanics: Illustrative Worked Examples. Elsevier Science, Oxford. 530 pp.
- Hatherly, P., Medhurst, T., MacGregor, S. 2008. Geophysical Strata Rating. ACARP project C15019. https://www.acarp.com.au/
- Hatherly, P., Medhurst, T., Zhou, B. 2013. Investigations for open pit geomechanics using geophysical logs, ACARP project C20025. https://www.acarp.com.au/
- Hoek, E. 2007. Practical Rock Engineering, Rocscience (online): https://www.rocscience.com/learning/hoek-s-corner.
- Hoek, E., Brown, E. 1980. Empirical strength criterion for rock masses. Journal of The Geotechnical Engineering Division. ASCE 106 (GT9), pp. 1013-1035.
- Hoek, E., Brown, E. 1988. The Hoek-Brown failure criterion – a 1988 update. Proceedings 15th Canadian Rock Mech. Symp. Toronto.
- Hoek, E., Marinos, P. 2007. A brief history of the development of the Hoek-Brown failure criterion. Soils and Rocks. No. 2.
- International Society for Rock Mechanics (ISRM) Commission on Standardization of Laboratory and Field Tests, 1978. Suggested methods for the quantitative description of discontinuities in rock masses. Int J Rock Mech Min Sci & Geomech Abstr. 15, pp. 319-368.
- Jaeger, J., Cook, N., Zimmerman, R. 2007. Fundamentals of Rock Mechanics (Fourth Edition). Blackwell Publishing, Oxford, UK.
- Mark, C., Molinda, G. 2005. The Coal Mine Roof Rating (CMRR) – A decade of experience. Intl J of Coal Geology. 64, pp. 85-103.
- Priest, S., Brown, E. 1983. Probabilistic stability analysis of variable rock slopes. Institution of Mining and Metallurgy Transactions. 92, pp. A1-A12.
- Sjoberg, J. 1999. Analysis of Large Scale Rock Slopes, Doctoral Thesis, Lulea University of Technology Department of Civil and Mining Engineering Division of Rock Mechanics, Sweden.
- Zhai, H., Canbulat, I., Hebblewhite, B., Zhang, C. 2017. Review of current empirical approaches for determination of the weak rock mass properties. Procedia Engineering. 191, pp. 908-917.

Recommended Resources

Other Resources

- MEA Report Writing Guide for Mining Engineers. P Hagan and P Mort (Mining Education Australia (MEA)). (Latest edition available for download from the School website or a hardcopy version is available from the UNSW Bookshop)
- Guide to Authors, 2008. (Australasian Institute of Mining and Metallurgy; Melbourne).
- Style Manual for authors, editors and printers. 6th edition, (John Wiley & Sons).

Online Resources Selected readings as well as other supporting material (e.g. course outline and lecture notes will be made available on Moodle.

Course Evaluation and Development

The student feedback will be recieved through myExperience.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Ismet Canbulat		159G	+61432003064	By appointment	No	Yes
	Ismet Canbulat					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;

- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

Course completion

Course completion requires submission of all assessment items. Failure to submit all assessment items may result in the award of an Unsatisfactory Failure (UF) grade for the Course unless special consideration has been submitted and approved.

Submission of Assessment Tasks

We encourage you to retain a copy of every assignment submitted for your own record, either in hardcopy or electronic form. All assessments must have an assessment cover sheet attached.

Student Resources

The School has student resources section, containing useful advice and information to ensure you're able to focus on your studies.

Computing Resources and Internet Access Requirements

UNSW Minerals and Energy Resources Engineering provides blended learning using the online Moodle LMS (Learning Management System). Also see - Transitioning to Online Learning: www.covid19studyonline.unsw.edu.au

Note that some specialist engineering software is not available for Mac computers.

- Mining Engineering Students: OMB G48
- Petroleum Engineering Students: TETB LG34 & LG35

For more information about system requirements is available at www.student.unsw.edu.au/moodle-system-requirements

Accessing Course Materials Through Moodle

Course outlines, support materials are uploaded to Moodle, the university standard Learning Management System (LMS). In addition, on-line assignment submissions are made using the assignment dropbox facility provided in Moodle. All enrolled students are automatically included in Moodle for each course. To access these documents and other course resources, please visit: www.moodle.telt.unsw.edu.au

School Contact Information

School of Minerals and Energy Resources
Old Main Building, Level 1, 159 (K15)
UNSW SYDNEY NSW 2052 AUSTRALIA

For current students, all enquiries and assistance relating to enrolment, class registration, progression checks and other administrative matters, please see The Nucleus: Student Hub.

Web & Important Links:

School of Minerals and Energy Resources
The Nucleus: Student Hub
Moodle
UNSW Handbook

UNSW Timetable

Student Wellbeing

Urgent Mental Health & Support

Equitable Learning Services