Faculty of Engineering

School of Minerals and Energy Resources Engineering

Postgraduate Course Outline

MINE8720

Numerical Methods in Mine Geomechanics

Dr Joung Oh

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1. INFORMATION ABOUT THE COURSE

Course Code:	MINE8720	Term:	T3, 2021	Level:	PG	Units/Credits	6 UOC
Course Name:	**Numerical Methods in Mine Geomechanics**						

Course Convenor:	***Dr Joung Oh***		
Contact Details	School of Minerals and Energy Resources Engineering, OLB – Rm159k	EMAIL:	joung.oh@unsw.edu.au
		Phone:	+61 2 9385 5002
Contact times	Contact times are scheduled for: • **5th to 8th of October as a Short Course**		

1.1. Course Description

This course expands on components of the MINE8140 Mining Geomechanics course to providing a more comprehensive and theoretical understanding of the engineering principles involved, together with practical mining industry application. The course is intended to demonstrate how closely numerical methods relate to their practical applications to mining rock mechanics and to equip the students with knowledge of key numerical methods used in mining engineering.
There is an increasing need for both engineering and geoscience professionals to understand, manage and, in many instances, undertake complex rock mechanics investigations. Even where professionals are involved in engaging specialist consultants, it is important that they have an understanding of the issues to be investigated, and the capabilities and limitations of rock mechanics design tools – whether they be stress analysis software packages, analytical methods or instrumentation.

This course is intended to extend personnel who already have an overview and basic understanding of mining geomechanics. It will equip them with a number of theoretical concepts and engineering principles, as well as relevant, practical rock mechanics design tools.
Specific areas covered in this course include: definition of a boundary value problem- equilibrium equations, constitutive models and boundary conditions; the theories and applications of Finite Element Method (FEM), Discrete Element Method (DEM) and Boundary Element Method (BEM) to mining engineering; practical use of a number of computational software packages.
The course is presented in the form of lectures, interactive discussions, tutorial sessions and hands-on practical work with stress analysis packages. It will be presented by a number of specialists from both within the university and from external specialist consultants.

1.2. Course Completion

Course completion requires submission of all assessment items; failure to submit all assessment items can result in the award of an Unsatisfactory Failure (UF) grade for the Course.

1.3. Assumed Knowledge

MINE8720 – Numerical Method in Mine Geomechanics follows on from MINE8140 Mining Geomechanics, and presents a more detailed consideration of stress analysis and the mechanical properties of rock and rock masses. It is assumed that all students will have either successfully completed MINE8140, or have reached an equivalent level of learning and/or experience.

2. AIMS, LEARNING OUTCOMES AND GRADUATE ATTRIBUTES

2.1. Course Aims

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

2.2. Learning Outcomes

It is intended that students will be able to:

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

2.3. Graduate Attributes

This course will contribute to the development of the following Graduate Attributes:

1. appropriate technical knowledge
2. having advanced problem solving, analysis and synthesis skills with the ability to tolerate ambiguity
3. ability for engineering design and creativity
4. awareness of opportunities to add value through engineering and the need for continuous improvement
5. being able to work and communicate effectively across discipline boundaries
6. having HSEC consciousness
7. being active life-long learners

3. REFERENCE RESOURCES

3.1. Reference Materials

- 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).
- ISRM Online Journals

(Note: This is not intended to be a complete list, but a guide only.)

3.2. Other Resources (if applicable)

- *Report Writing Guide for Mining Engineers,* 2011. P Hagan & P Mort (Mining Education Australia (MEA) ISBN 978 0 7334 3032 9.

- *Guide to Authors,* 2008. (Australasian Institute of Mining and Metallurgy; Melbourne).

- *Style Manual for authors, editors and printers.* 6th edition, (John Wiley & Sons)

3.3. Online Resources

Selected readings as well as other supporting material (e.g. course outline and lecture notes will be made available on Moodle.
Videos are often provided to students as a web stream within the Moodle learning management system. Videos are not available for download by students, unless approved by the Course Convenor and either the Undergraduate or Postgraduate Coursework Director. Special consideration can be provided for students to access videos off-line (eg. working remotely). Please contact the Course Convenor for more information. Note that UNSW reserves the right to deliver videos as a web stream rather than off-line, and cannot provide videos that are copyright from other providers.

3.4. Software and Hardware

- RS2
- Map3D
- UNSWEDGE/SWEDGE/DIPS
- RockLab/RocData

4. COURSE CONTENT AND LEARNING ACTIVITIES

4.1. Learning Activities Summary

Tuesday 5 October:

Time	Activity	Lecturer
9:00 – 9:30	Course Introduction & Structure	JO
9:30 – 10:30	Numerical Methods in Rock Engineering intro	JO
10:30 – 11:00	**Morning Tea**	
11:00 – 12:30	DEM Analysis for Borehole Breakout Behaviour	SX
12:30 – 13:30	**Lunch**	
13:30 – 15:00	Numerical Analysis - Theory	MZ
15:00 – 15:30	**Afternoon Tea**	
15:30 – 17:00	Computer Lab Class – FEM	JO/CZ

Wednesday 6 October:

Time	Activity	Lecturer
9:00 – 10:30	Numerical Analysis – Case Histories	DB
10:30 – 11:00	**Morning Tea**	
11:00 – 12:30	Numerical Analysis – Case Histories (cont'd)	DB
12:30 – 13:30	**Lunch**	
13:30 – 15:00	Numerical Analysis – Case Histories (cont'd)	DB
15:00 – 15:30	**Afternoon Tea**	
15:30 – 17:00	Numerical Modelling Applications to Surface Mining	DG

Thursday 7 October:

Time	Activity	Lecturer
9:00 – 10:30	Continuum Modelling approach - Theory	MK
10:30 – 11:00	**Morning Tea**	
11:00 – 12:30	Continuum Modelling Approach – Mining Applications	MK
12:30 – 13:30	**Lunch**	
13:30 – 15:00	Numerical Analysis - Applications	MZ
15:00 – 15:30	**Afternoon Tea**	
15:30 – 17:00	Numerical analysis for excavation in hard/crystalline rock masses	DM

Friday 8 October:

Time	Activity	Lecturer
9:00 – 10:30	DEM & Limit Equilibrium – Theory & Application	JO
10:30 – 11:00	**Morning Tea**	
11:00 – 12:30	Computer Lab Class - BEM	JO/CZ
12:30 – 13:30	**Lunch**	
13:30 – 15:00	Computer Lab Class - Assignments	JO/CZ

Total student effort hours: Approx. 150

(Note: The above indication of "student effort hours" is indicative only – It reflects the anticipated level of total student involvement with the course – either through accessing or participating in online materials and activities; private research; preparation of assignments. Individual students may find their level of involvement differs from this schedule.

4.2. Presenters

Name	Contact Details
Dr JOUNG OH **Senior Lecturer: UNSW Room 159K**	**Email:** joung.oh@unsw.edu.au **Address:** School of Mining Engineering The University of New South Wales Sydney 2052 Australia **PH:** 02 93855002
Dr CHENGGUO ZHANG **Senior Lecturer: UNSW Room 163**	**Email:** chengguo.zhang@unsw.edu.au **Address:** School of Mining Engineering The University of New South Wales Sydney 2052 Australia
Dr DAVID BECK **General Manager of Beck Engineering Pty Ltd**	Email: dbeck@beck.engineering **Address**: Beck Engineering Pty Ltd Sydney 2052 Australia +61 412135782
Dr Mahdi ZOORABADI **Technical Principal, Geotechnics & Tunnels at SMEC**	**Email:** Mahdi.Zoorbadi@smec.com **Address:** Collins Square, Tower 4, Level 20, 727 Collins St, Melbourne, VIC, 3008, Australia
Dr Mattin KHISHVAND **Senior Geotechnical Engineer, Blackrock Mining Solutions**	**Email:** m.khishvand@blackrockmining.net **Address:** Level 6, 40 Creek Street, Brisbane City, Queensland, 4000 Australia

5. COURSE ASSESSMENT

5.1. Assessment Summary

Item No.	*Assessment*	*Due date*	*Weighting*	*Learning outcomes*
A01	Limit Equilibrium (**Technical report**)	12 Nov	40%	1-4
A02	BEM (**Technical report**)	12 Nov	60%	1-4

NOTE: Course completion requires that **all** assessment items be completed, and all short course sessions must be attended. Assessment items should be submitted by 5:00pm, 12 NOV 2021 to avoid penalty marks.

6. ASSESSMENT CRITERIA

Assignments and examination

Answers may be numerical, graphical or descriptive.

Answer is correct and substantiated by complete mathematical working	100%
Deduct for incorrect or unspecified units	20%
Deduct for excessive roundoff error	10%
Answer is correct but not substantiated by complete, correct working	up to 30% depending upon how much of the correct working is given
Answer is incorrect but principles of mathematical working are correct	60%
Add if the answer is of reasonable Magnitude	20%
Add if incorrect only because of an error of transcription of numerical data	10%
Mathematical working is incomplete or incorrect	up to 50% depending upon how much of the correct working is given

Graphical answers

Accuracy with which the data are presented	60%
Layout	20%
Tidiness	20%

Descriptive answers

Completeness and accuracy of answer	70%
Clarity of expression	30%
Deduct for irrelevant material	up to 40%

7. STUDYING A UG COURSE IN UNSW MINERALS AND ENERGY RESOURCES ENGINEERING

7.1. How We Contact You

At times, the School or your course conveners may need to contact you about your course or your enrolment. Your course conveners will use the email function within Moodle or we will contact you on your @student.unsw.edu.au email address.

We understand that you may have an existing email account and would prefer for your UNSW emails to be redirected to your preferred account. Please see these instructions on how to redirect your UNSW emails: https://www.it.unsw.edu.au/students/email/index.html

7.2. How You Can Contact Us

We are always ready to assist you with your inquiries. To ensure your question is directed to the correct person, please use the email address below for:

Enrolment or other admin questions regarding your program: https://unswinsight.microsoftcrmportals.com/web-forms/

Course inquiries: these should be directed to the Course Convenor.

7.3. Computing Resources and Internet Access Requirements

UNSW Minerals and Energy Resources Engineering provides blended learning using the on-line Moodle LMS (Learning Management System).

It is essential that you have access to a PC or notebook computer. Mobile devices such as smart phones and tablets may compliment learning, but access to a PC or notebook computer is also required. Note that some specialist engineering software is not available for Mac computers.

Mining Engineering Students: OMB G48/49
Petroleum Engineering Students: TETB

It is recommended that you have regular internet access to participate in forum discussion and group work. To run Moodle most effectively, you should have:

- broadband connection (256 kbit/sec or faster)
- ability to view streaming video (high or low definition UNSW TV options)

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

7.4. 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

7.5. Assignment Submissions

The School has developed a guideline to help you when submitting a course assignment.

We encourage you to retain a copy of every assignment submitted for assessment for your own record either in hardcopy or electronic form.

All assessments must have an assessment cover sheet attached.

7.6. Late Submission of an Assignment

Full marks for an assignment are only possible when an assignment is received by the due date. In fairness to those students who do meet the assignment due date and time, deductions will apply to submissions made after this time. Details on deductions that are automatically applied to late submissions are available on our webpage: www.engineering.unsw.edu.au/mining-engineering/late-submissions

We understand that at times you may not be able to submit an assignment on time, and the School will accommodate any fair and reasonable extension. We would recommend you review the UNSW Special Consideration guidelines – see following section.

In the case of the Project Progress Report, penalty marks will be applied at the following rate if submitted after the due date: five (5) percentile points of the maximum possible mark for each day or part thereof that the assessment is overdue.

For example if a student submitted the Project Progress Report five days after the due date and the unadjusted mark was 68% then the final adjustment mark for the assignment would be 43%; that is the raw mark of 68% less 25 percentile points (5 days @ 5 percentile points per day).

7.7. Special Consideration

You can apply for special consideration through UNSW Student Central when illness or other circumstances interfere with your assessment performance. Sickness, misadventure or other circumstances beyond your control may:

- Prevent you from completing a course requirement,
- Keep you from attending an assessable activity,
- Stop you submitting assessable work for a course,
- Significantly affect your performance in assessable work, be it a formal end-of-semester examination, a class test, a laboratory test, a seminar presentation or any other form of assessment.

We ask that you please contact the Course Convener immediately once you have completed the special consideration application, no later than one week from submission.

More details on special consideration can be found at: www.student.unsw.edu.au/special-consideration

7.8. Course Results

For details on UNSW assessment policy, please visit: www.student.unsw.edu.au/assessment

In some instances, your final course result may be withheld and not released on the UNSW planned date. This is indicated by a course grade result of either:

- WD – which usually indicates you have not completed one or more items of assessment or there is an issue with one or more assignment; or
- WC – which indicates you have applied for Special Consideration due to illness or misadventure and the course results have not been finalised.

In either event it would be your responsibility to contact the Course Convener as soon as practicable but no later than five (5) days after release of the course result. If you don't contact the convener on time, you may be required to re-submit an assignment or re-sit the final exam and may result in you failing the course. You would also have a NC (course not completed) mark on your transcript and would need to re-enroll in the course.

7.9. Students Needing Additional Support

The Student Equity and Disabilities Unit (SEADU) aims to provide all students with support and professional advice when circumstances may prevent students from achieving a successful university education. Take a look at their webpage: www.studentequity.unsw.edu.au/

7.10. Academic Honesty and Plagiarism

Your lecturer and the University will expect your submitted assignments are truly your own work. UNSW has very clear guidelines on what plagiarism is and how to avoid it. Plagiarism is using the words or ideas of others and presenting them 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. The University has adopted an educative approach to plagiarism and has developed a range of resources to support students. All the details on plagiarism, including some useful resources, can be found at www.student.unsw.edu.au/plagiarism.

All Mining Engineering students are required to complete a student declaration for academic integrity which is outlined in the assignment cover sheets. By signing this declaration, you agree that your work is your own original work.

If you need some additional support with your writing skills, please contact the Learning Centre or view some of the resources on their website: http://www.lc.unsw.edu.au/. The Learning Centre is designed to help you improve your academic writing and communication skills. Some students use the Centre services because they are finding their assignments a challenge, others because they want to improve an already successful academic performance.

7.11. Continual Course Improvement

At the end of each course, all students will have the opportunity to complete a course evaluation form. These anonymous surveys help us understand your views of the course, your lecturers and the course materials. We are continuously improving our courses based on student feedback, and your perspective is valuable.

Feedback is given via https://student.unsw.edu.au/myexperience and you will be notified when this is available for you to complete.

We also encourage all students to share any feedback they have any time during the course – if you have a concern, please contact us immediately.

8. SCHOOL ASSESSMENT COVER SHEET

School of Minerals and Energy Resources Engineering

Assessment Cover Sheet

Course Convenor: _____

Course Code: _____ Course Title: _____

Assignment: _____

Due Date: _____

Student Name: _____ Student ID: _____

ACADEMIC REQUIREMENTS

Before submitting this assignment, the student is advised to review:

- the assessment requirements contained in the briefing document for the assignment;
- the various matters related to assessment in the relevant Course Outline; and
- the *Plagiarism and Academic Integrity* website at < http:/www.lc.unsw.edu.au/plagiarism/pintro.html > to ensure they are familiar with the requirements to provide appropriate acknowledgement of source materials.

If after reviewing this material there is any doubt about assessment requirements, then in the first instance the student should consult with the Course Convenor and then if necessary with the Director – Undergraduate Studies.

While students are generally encouraged to work with other students to enhance learning, all assignments submitted for assessment must be their entire own work and duly acknowledge the use of other person's work or material. The student may be required to explain any or all parts of the assignment to the Course Convenor or other authorised persons. *Plagiarism* is using the work of others in whole or part without appropriate acknowledgement within the assignment in the required form. *Collusion* is where another person(s) assists in the preparation of a student's assignment without the consent or knowledge of the Course Convenor.

Plagiarism and *Collusion* are considered as Academic Misconduct and will be dealt with according to University Policy.

STUDENT DECLARATION OF ACADEMIC INTEGRITY

I declare that:

- This assessment item is entirely my own original work, except where I have acknowledged use of source material [such as books, journal articles, other published material, the Internet, and the work of other student/s or any other person/s].
- This assessment item has not been submitted for assessment for academic credit in this, or any other course, at UNSW or elsewhere.

I understand that:

- The assessor of this assessment item may, for the purpose of assessing this item, reproduce this assessment item and provide a copy to another member of the University.
- The assessor may communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

Student Signature: Date:

Students are advised to retain a copy of this assessment for their records and submission should be made in accordance to the assessment details available on the course Moodle site.