



Faculty of Engineering

**School of Minerals and Energy Resources Engineering**

Postgraduate Course Outline

**MINE8860  
Drilling, Blasting & Machine Mining**

Dr Joung Oh

**Term 3, 2021**

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## Document Management

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## 1. INFORMATION ABOUT THE COURSE

Course Code:	MINE8860	Term:	T3, 2021	Level:	PG	Units/Credits	6 UOC
Course Name:	<b>Drilling, Blasting and Machine Mining</b>						

Course Convenor:	<b>Dr Joung Oh</b>						
Contact Details	School of Minerals & Energy Resources Engineering, Old Main Building, Rm 159k			Email:	joung.oh@unsw.edu.au		
				Phone:	+61 2 9385 5002		
Contact times	<b>9:00 am Monday 20 September to 4:00 pm Thursday 23 September</b>						

### 1.1 Course Description

The course will address the mechanics and practical applications and current technologies in rock fragmentation; theories of rock breakage and fragmentation; rock mass properties; structure and discontinuities and their impact on blast behaviour. Blasting theories and types of explosives and blast initiation procedures; blast designs for both underground and surface mining applications; blast hazard management; blast vibration and impact on structures and mining excavations; state-of-the-art blasting practices and technologies; and alternatives to conventional blasting for rock fragmentation.

Production drilling methods and equipment, bits and drilling accessories.

Principles of coal and rock cutting mechanics; the performance of picks and free rolling cutters; cutting tool interaction; the design of cutting arrays for machine mining and tunnelling; impact breakage of rock; drill bit design and breakage mechanics; cutting tool materials and the effects of wear; methods of assessing rock cuttability; water jet cutting and water jet assisted drilling and cutting. Applications including full face and partial mining machines, drilling technologies and tunnel boring machines will be reviewed.

### 1.2 Course Completion

Course completion requires:

- submission of all assessment items; failure to submit all assessment items will result in the award of an **Unsatisfactory Failure (UF)** grade for the Course.

### 1.3 Assumed Knowledge

This course assumes a student has prior 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; and
- mining systems including means of rock breakage and materials handling.

### 1.4 Attendance

To pass this course it is expected that you will attend at least 80% of tutorials and lectures. If you have misadventure or ill-health, please contact your course coordinator soon as possible. The attendance requirement is not meant to be punitive. It is included because participation is an important part of achieving the course outcomes.

## **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 rock breakage techniques for different mining applications.

### **2.2 Learning Outcomes**

At the conclusion of this course, students should be able to:

1. explain the contribution and influence of rock breakage to the stream of mining processes and in particular the mine-to-mill concept
2. describe the various methods of rock breakage
3. select appropriate methods of rock breakage for given in-situ rock conditions
4. apply fundamental principles to the design and selection of safe and efficient blasting and machine mining to:
  - design blasts to achieve particular outcomes
  - manage and control blast damage and environmental impacts
  - optimise design of cutterheads
  - evaluate productivity and economics
5. identify relevant requirements for the security, storage and handling of explosives

### 3. REFERENCE RESOURCES

#### 3.1 Reference Materials

- William Hustrulid. *Blasting principles for open pit mining and theoretical foundations*, Rotterdam : A.A. Balkema, 1999.
- *Practical Blasting Fundamentals*, International Society of Explosives Engineers
- Carlos Lopez Jimeno, Emilio Lopez Jimeno, Francisco Javier Ayala Carcedo. *Drilling and blasting of rocks*, Rotterdam, Ne.: A.A. Balkema, c1995.
- *Open Pit Blast Design – analysis and optimisation*, JKMRRC Monograph 1, University of Queensland, 1996.
- *Rock Excavation Handbook*, Sandvik Tamrock Corporation, 1999
- Per-Anders Persson, Roger Holmberg, Jaimin Lee. *Rock blasting and explosives engineering*, Boca Raton, Fla.: CRC Press, 1994.
- Hustrulid, WA, Bullock, R. (Editors), 2001. *Underground Mining Methods: Engineering Fundamentals and International Case Studies*. (Society for Mining Metallurgy & Exploration: Littleton), 728p.
- *SME Mining Engineering Handbook*, 2011, editor, Howard L Hartman
- Cost Estimation Handbook for the Australian Mining Industry, AusIMM
- [www.austlii.edu.au](http://www.austlii.edu.au) – for all Acts & Regulations for all states and territories
- Australian Standard AS2187. Terminology, use and storage of explosives

#### 3.2 Other Resources

Other material that should be referred to in conjunction with this Course Outline include:

- *Elements of Machine Mining*, the Course Reader by FF Roxborough
- *Report Writing Guide for 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*. (Australasian Institute of Mining and Metallurgy: Melbourne) (Available for download from the AusIMM website)

#### 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 Report Writing Guide for Engineers

Please refer to resources section in Moodle.

## 4. COURSE CONTENT AND LEARNING ACTIVITIES

### 4.1 Learning Activities Summary

The schedule of learning activities and outcomes for the course are listed in Table 1.

**Table 1. Schedule of topics and activities in the course.**

Day	Theme	Content/Activities	Presenter
1	Course Introduction Blasting	Course introduction Theory of rock breakage using explosives Blast Management	JO/PD
2	Blasting	Introduction of drilling and blasting Drilling Theory of rock breakage using explosives Surface blast design Underground blast design	PD
3	Blasting	Initiation systems design Ground vibration Wall control Blast optimisation Blast economics and cost optimisation	PD
4	Machine Mining	Forms of rock breakage Models of rock breakage of pick & disc cutters Performance of pick & disc cutting tools Machine analysis <ul style="list-style-type: none"> <li>• pick cutting machines</li> <li>• disc cutting machines</li> </ul>	JO

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.

## 5. COURSE ASSESSMENT

### 5.1 Assessment Summary

**Table 2.** Course Assessment and Due Dates.

Assessment task No.	Due date	Weight	Assessment	Learning outcomes assessed
A01	29 Oct	20%	Quiz - <b>Machine Excavation</b>	4
A02	29 Oct	80%	20 quizzes (16%) and 4 Assignments (64%) - <b>Drill &amp; Blast</b>	1-5

### 5.2 Assessment Requirements

#### Who

- The Major Assignment must be submitted to the Course Convenor.

#### When

- The Major Assignment must be submitted before close of normal business hours (i.e. 5:00pm) on the date specified at the table above.
- Early submission is required in cases where the student will otherwise be absent on the due date of submission, for example to attend the Student Mining Games, a graduate employment interview etc. – no extensions will be granted.
- Prior to submission, students should read the School Policy on *Assignment Submissions* which can be viewed at: < [www.mining.unsw.edu.au/information-about/our-school/policies-procedures-guidelines](http://www.mining.unsw.edu.au/information-about/our-school/policies-procedures-guidelines) >.
- In particular, the student should make sure they have read and understood the:
  - Declaration of Academic Integrity;
  - Assignment Submission requirements detailed in the *University Policies* section of the Course Outline; and
  - School Policy on *Assignment Submission* available on the School's website (the web address is given in the Course Outline). In particular note the requirement that only PDF documents should be uploaded and the required file naming convention.

#### Where

- *Submissions must be made electronically* through Turnitin in the Moodle unless otherwise stated. Turnitin is a plagiarism checking service that will retain a copy of the assessment item on its database for the purpose of future plagiarism checking.

#### What

- The submission must be:
  - a single document in PDF format; and
  - prepared in the form of a formal report that includes a list of reference sources cited in the report, prepared in accordance with the report writing standards of the School as contained in the **Report Writing Guide for Engineers**. A hardcopy can be obtained

from the UNSW Bookshop or a softcopy downloaded from the School webpage.

- Each submission must have appended:
  - to the front, a signed copy of the Student Declaration Form and Coversheet; and
  - to the end, a copy of the Assessment Criteria.

Copies of both documents are available for download from Moodle.

- It is **strongly recommended** when preparing the major assignment; students use the **Report Template** available from Moodle. Note: as this template already incorporates the required the Student Declaration Form, a student does not need to separately append a signed copy of coversheet to their assignment.

### How

- The name of the document must be consistent with the standard file naming convention as stated in the Assignment Submission, these being:

**FamilyNameInitials\_CourseCode\_AssignmentNumber.pdf**

- An example of a typical filename that follows this file naming convention would be:  
**SmithPD\_MINE4951\_A01.pdf**

which elements correspond to:

- Family name of student: **Smith**
- First and second initial(s) of student: **PD**
- Course Code: **MINE4951**
- Relevant assignment number as defined in Table 2: **A01** for the assessment task *Project Proposal*
- File format: **PDF** document

### 5.3 Penalties for Non-Compliant Submission

A submission that is non-compliant with the School Policy on *Assignment Submission* and/or requirements as contained in this Course Outline may not be marked and/or penalty marks subtracted from the assignment mark for non-compliance.

Some examples of a non-compliant assignment include that the assignment submission:

- is not a single PDF document. *Penalty for non-compliance:* assignment not marked.
- does not contain a signed copy of the *Student Declaration Statement*. *Penalty for non-compliance:* assignment not marked.
- is not fully consistent with the designated file naming convention as listed above and defined as Item #6 in the School Policy on electronic submission. For example, a file name such as < ProjectProposal.pdf > is NOT compliant. *Penalty for non-compliance:* 10 marks.
- does not have appended at the end of the assignment a copy of the official *Assessment Criteria* template. *Penalty for non-compliance:* 5 marks.

Assignments related details/submission-box will be available online through Moodle. Access to the Moodle site is via the Moodle icon on the MyUNSW homepage.

### 5.4 ASSESSMENT CRITERIA

Each assignment submitted for assessment must be attached with:

- an official School Coversheet at the front of the assignment; and
- the requisite Assessment Criteria form at the end of the assignment with the self-assessment completed by the student.



## 6. STUDYING A PG COURSE IN MINING ENGINEERING AT UNSW

### 6.1 How We Contact You

At times, the School or your lecturers may need to contact you about your course or your enrolment. Your lecturers will use the email function through 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>

### 6.2 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.

### 6.3 Computing Resources and Internet Access Requirements

The School 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.

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)
- Chrome browser or FireFox
- ability to view streaming video (high or low definition UNSW The Box options)

More information about system requirements is available at [www.student.unsw.edu.au/moodle-system-requirements](http://www.student.unsw.edu.au/moodle-system-requirements).

### 6.4 Accessing Course Materials Through Moodle

Course outlines and support materials are uploaded on a Learning Management System (LMS) - Moodle. All enrolled students are automatically included on the Moodle for each course. To access these documents, please visit: [www.moodle.telt.unsw.edu.au](http://www.moodle.telt.unsw.edu.au)

### 6.5 Assessment Criteria for Postgraduate programs

The assessment criteria provide a framework for you to assess your own work before formally submitting major assignments to your facilitator. Your facilitator will be using this framework to assess you work and as a way to assess whether you have met the listed learning outcomes and the graduate attributes for your program. All students are encouraged to take a closer look at this framework before, during and after completing an assignment.

The descriptions in the framework will help you and your facilitator to identify where your assignment is ranked – from excellent to poor achievement. We ask that you don't use the guidelines as a checklist, but as a tool to assess the quality of your work. Your facilitator will also be looking at the quality, creativity and the presentation of your written assignment as they review the framework.

## 6.6 Assignment Submissions

The School has developed a guideline to help you when submitting a course assignment. Please take a closer look at all these details on our website: [www.engineering.unsw.edu.au/mining-engineering/assignment-submission-policy](http://www.engineering.unsw.edu.au/mining-engineering/assignment-submission-policy)

We encourage you to retain a copy of every assignment submitted for assessment for your own record either in hardcopy or electronic form. On a rare occasion, assignments may be mislaid and we may contact you to re-submit your assignment.

All your assignments will need to have a completed PG coversheet. Attached to this course outline.

## 6.7 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: <http://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 as soon as possible: <https://student.unsw.edu.au/special-consideration>

## 6.8 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 Convenor 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: <https://student.unsw.edu.au/special-consideration>

## 6.9 Course Results

For details on UNSW assessment policy, please visit: <https://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 Convenor as soon as practicable but no later than five (5) days after release of the course result. If you don't contact the convenor 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.

## 6.10 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/](http://www.studentequity.unsw.edu.au/)

## 6.11 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 <https://student.unsw.edu.au/plagiarism>

All 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.

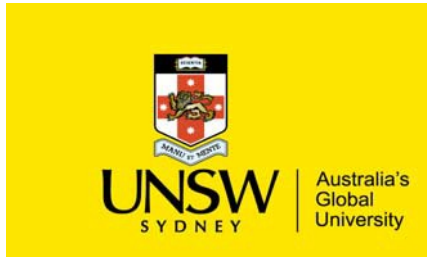
## 6.12 Continual Course Improvement

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.

# SCHOOL ASSESSMENT COVER SHEET



## School of Minerals and Energy Resources Engineering Assessment Cover Sheet

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: \_\_\_\_\_  
MINE8860 Drilling, Blasting & Machine Mining

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.