



## UNSW Course Outline

# MINE3630 Rock Breakage - 2024

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## General Course Information

**Course Code :** MINE3630

**Year :** 2024

**Term :** Term 3

**Teaching Period :** T3

**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 :** Undergraduate

**Units of Credit :** 6

### Useful Links

[Handbook Class Timetable](#)

## Course Details & Outcomes

### Course Description

This course covers the principal methods of rock breakage used in mining including machine mining, drilling and blasting. Machine mining encompasses rock cutting principles, cutting with picks and discs, the design of cutter heads, effect of wear, assessment of rock cuttability, impact breakage and ripping. Drilling encompasses the methods of drilling used in mining and the

impact of drilling parameters on performance and selection and costing of drilling equipment. Blasting encompasses the chemistry of explosives and mechanics of explosive-rock interaction, selection of commercial explosives, explosive charging techniques, initiation and delay systems, blast design principles for surface and underground mines, safety, environmental and regulatory management and blast performance assessment and analysis. The course introduces how an emerging rock breakage technology can be applied to mining and illustrates the application of simulation of drill and blast technique to the blast design for surface and underground mines.

## 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.

## Course Learning Outcomes

Course Learning Outcomes
CL01 : Examine the various methods of rock breakage
CL02 : Select and evaluate appropriate methods of drilling and rock breakage for given in-situ rock conditions and mining systems
CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities
CL04 : Identify relevant requirements for the security, storage and handling of explosives

Course Learning Outcomes	Assessment Item
CL01 : Examine the various methods of rock breakage	<ul style="list-style-type: none"> <li>• Group Assignment</li> <li>• Online Quiz: Machine Mining</li> <li>• Seminar Presentation</li> <li>• Final Exam</li> </ul>
CL02 : Select and evaluate appropriate methods of drilling and rock breakage for given in-situ rock conditions and mining systems	<ul style="list-style-type: none"> <li>• Group Assignment</li> <li>• Online Quiz: Machine Mining</li> <li>• Seminar Presentation</li> </ul>
CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities	<ul style="list-style-type: none"> <li>• Final Exam</li> <li>• Group Assignment</li> <li>• Online Quiz: Machine Mining</li> <li>• Seminar Presentation</li> </ul>
CL04 : Identify relevant requirements for the security, storage and handling of explosives	<ul style="list-style-type: none"> <li>• Final Exam</li> <li>• Group Assignment</li> <li>• Seminar Presentation</li> </ul>

# Learning and Teaching Technologies

Moodle - Learning Management System

## Additional Course Information

This course involves the following topics:

- *Mechanics of rock breakage and fragmentation*
  - machine mining
  - blasting
- *Machine mining*
  - types of mining machines
  - design variables and performance of pick and disc cutting tools
  - cutting tool materials and effect of tool metallurgy on wear and fracture resistance
  - cutterhead design for mining machines
  - methods of assessment of rock cuttability
  - ripping and impact breaking
- *Drilling techniques for blasting*
  - types of drilling machines and drilling methods
  - selection, performance and costing of different drilling machines
  - safety and logistics of drilling machines
- *Explosive breakage*
  - detonation and explosive performance
  - types, properties and selection of commercial explosives
  - charging techniques, initiation systems, blasting accessories and their applications
  - rock mass characterisation for blasting
  - blast design principles and practices
- bench blasting
- open pit coal blasting
- underground blasting
- special blasting techniques
  - management of blast damage
  - cast blasting
  - secondary blasting
- blast fragmentation and analysis
- environmental management
- relevant legislation and standards

# Assessments

## Assessment Structure

Assessment Item	Weight	Relevant Dates
Group Assignment Assessment Format: Group	25%	Start Date: Week 4 Due Date: Week 9
Online Quiz: Machine Mining Assessment Format: Individual	30%	Start Date: TBA in the class Due Date: Not Applicable
Seminar Presentation Assessment Format: Individual	10%	Start Date: TBA in the class Due Date: Not Applicable
Final Exam Assessment Format: Individual	35%	Start Date: Not Applicable Due Date: Not Applicable

## Assessment Details

### Group Assignment

#### Assessment Overview

Group report to prepare blast designs, costing and other analyses for a given surface or underground mining operation

Marking will be done with a rubric and feedback will be provided in class during assignment review.

#### Course Learning Outcomes

- CL01 : Examine the various methods of rock breakage
- CL02 : Select and evaluate appropriate methods of drilling and rock breakage for given in-situ rock conditions and mining systems
- CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities
- CL04 : Identify relevant requirements for the security, storage and handling of explosives

#### Detailed Assessment Description

Detailed rubric is provided to the students on the Moodle

#### Assessment information

A group assignment which is subject to a Peer Review to prepare blast designs, costing and other analyses for a given surface mining operation or underground operation

#### Assignment submission Turnitin type

Not Applicable

## Generative AI Permission Level

### No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

## Online Quiz: Machine Mining

### Assessment Overview

Students are to complete multiple-choice test, covering all aspects of machine mining covered in the class.

Feedback will be provided within once week via the learning management system (LMS)

### Course Learning Outcomes

- CL01 : Examine the various methods of rock breakage
- CL02 : Select and evaluate appropriate methods of drilling and rock breakage for given in-situ rock conditions and mining systems
- CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities

### Detailed Assessment Description

Multiple-choice questions.

### Assessment information

- The in-semester quiz for the machine mining module may be either paper-based or conducted on-line using Moodle in the School of Mining Engineering Computer Laboratory, OMB Rm 48.
- The quiz will be scheduled during the normal lecture period or either on a Thursday or Friday in the nominated week between 10am and 2pm.
- The duration of the quiz will be approximately 60 minutes. Students should make provision in the diary to be available during these periods in the nominated weeks.
- Non-attendance at the Quiz will result in a zero mark. No supplementary quiz will be scheduled.
- The Quiz will cover the various learning outcomes as defined in the *Course Outline* and the material outlined in the *Learning Guides*.
- The Quiz will include a combination of multiple answer, short answer and calculation style questions selected at random from a bank of questions.
- Normal university regulations for examinations will apply to the Quiz.
- Students must also bring to the Quiz a *Quiz Summary Sheet (QSS)*. Preparation of the QSS is regarded as a key part of the learning process and so students are strongly encouraged to

prepare their own QSS. Requirements of the QSS are:

- it must be the student's own work;
- it must be a single A4 sheet of paper with notes placed on both sides of the sheet;
- the sheet must contain only **handwritten** notes and diagrams. It must NOT contain any typed, photocopied or computer generated information;
- it must be the individual student's own work written in pencil and/or pen. A photocopy is NOT allowed;
- there are no constraints on the size or amount of information that can be included; and
- the student's name and signature must be placed in the top right hand corner of the QSS with the statement "I declare this QSS is all my own work."
- If a QSS does not comply with all of these requirements then it may be confiscated and the student will not have recourse to the QSS during the Quiz. Academic Misconduct procedures may also be applied.
- The QSS must be surrendered at the end of the Quiz. The QSS will be checked but will not be assessed, so students can elect to submit a blank QSS. Students who do not submit a QSS will get zero marks for the Quiz.
- The QSS will not returned to students. Students are advised to make a copy for their own use.
- Students should bring to the Quiz a
  - calculator,
  - pen and pencil,
  - the Quiz Summary Sheet and
  - their Student ID card.

A blank sheet of paper for workings will be provided.

#### Assignment submission Turnitin type

Not Applicable

#### Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.

For more information on Generative AI and permitted use please see [here](#).

## **Seminar Presentation**

#### Assessment Overview

The 15-minute presentation and 5 minutes Q/A

Marking will be done with a rubric and feedback will be provided in class during assignment

review.

### **Course Learning Outcomes**

- CL01 : Examine the various methods of rock breakage
- CL02 : Select and evaluate appropriate methods of drilling and rock breakage for given in-situ rock conditions and mining systems
- CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities
- CL04 : Identify relevant requirements for the security, storage and handling of explosives

### **Detailed Assessment Description**

Detailed rubric will be provided to the students on the Moodle.

### **Assignment submission Turnitin type**

Not Applicable

### **Generative AI Permission Level**

**No Assistance**

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

## **Final Exam**

### **Assessment Overview**

2 hours Final exam for Cover Drill and Blast content.

### **Course Learning Outcomes**

- CL01 : Examine the various methods of rock breakage
- CL03 : Apply fundamental principles to the design and selection of safe and efficient rock breakage with consideration of emerging technology opportunities
- CL04 : Identify relevant requirements for the security, storage and handling of explosives

### **Detailed Assessment Description**

The final exam will cover Drill and Blast.

### **Assignment submission Turnitin type**

Not Applicable

### **Generative AI Permission Level**

**No Assistance**

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

## General Assessment Information

### Grading Basis

Standard

## Course Schedule

### Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

### General Schedule Information

Learning Activities Summary for each week is available on the Moodle.

## Course Resources

### Prescribed Resources

The School has a Report Writing Guide available. A copy of this is available on the course Moodle site.

### Recommended Resources

- *ISEE Blasters Handbook. Society of Explosives Engineers Inc. 18<sup>th</sup> edition, 2011 (International Society of Explosives Engineers: Cleveland, USA).*
- *Blasting principles for open pit mining and theoretical foundations. William Hustrulid. Rotterdam: A.A. Balkema, 1999.*
- *Practical Blasting Fundamentals, International Society of Explosives Engineers*
- *Drilling and blasting of rocks. Carlos Lopez Jimeno, Emilio Lopez Jimeno, Francisco Javier Ayala Carcedo. , Rotterdam, Ne.: A.A. Balkema, c1995.*
- *Open Pit Blast Design – analysis and optimisation, JKMRC Monograph 1, University of Queensland, 1996.*
- *Rock Excavation Handbook, Sandvik Tamrock Corporation, 1999*
- *Rock Blasting and Explosives Engineering. Per-Anders Persson, Roger Holmberg, Jaimin Lee., Boca Raton, Fla.: CRC Press, 1994.*
- *Underground Mining Methods: Engineering Fundamentals and International Case Studies.*



Hustrulid, WA, Bullock, R. (ed.), 2001. (Society for Mining Metallurgy & Exploration: Littleton), 728p.

- SME Mining Engineering Handbook, 2011, Peter Darling (ed.), ISBN 978 0 87335 264 2
- 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

## Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Joung Oh					No	Yes
	Brad Gyngell					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 policies. 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 Plagiarism

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](https://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](http://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 (if required).

### **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:

<https://www.student.unsw.edu.au/transitioning-online-learning>

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](http://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](http://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](#)