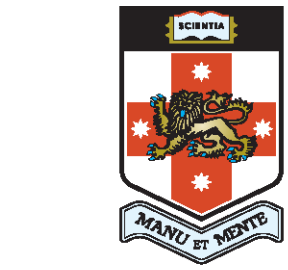

UNSW
SYDNEY

Faculty of Engineering

School of Minerals and Energy Resources Engineering

MINE5050

Ground Control Principles and Practice in Underground Coal Mining

T1 2021

Ismet Canbulat

CONTENTS

1 INFORMATION ABOUT THE COURSE

Course Code:	MINE5050	Term:	T1, 2021	Level:	PG	Units/Credits	6 UOC
Course Name:	**Ground Control Principles and Practice in Underground Coal Mining**						

Course Convenor:	***Prof Ismet Canbulat***		
Contact Details	School of Minerals and Energy Resources Engineering Old Main Building - Rm 159G	EMAIL:	i.canbulat@unsw.edu.au
		Phone:	+61 2 9385 0721
Contact times	**This course will be delivered in T1 in a hybrid mode (face-to-face and online). Please see Moodle for presentation times and requirements.**		

1.1 Course Description

Welcome to MINE/MNNG5050, ground control principles and practice in underground coal mining.

This course looks at the principles of rock reinforcement; active/passive support; support requirements for different excavation types and mining methods; ground reaction curves; load and displacement controlled support response; types of ground support/reinforcement hardware and related systems; design of support systems; interaction of mining method, layout and reinforcement systems; ground support installation and quality assurance; time effects on ground support systems and remedial options. Risk-based ground support systems and the integration of these systems into ground control management also form a major component of this course. An underground visit will also take place as part of this course.

This course is an Intensive, five-day workshop program conducted at UNSW from 1 to 5 April 2019.

How much time is required?

This course is worth 6 UOC. It will be presented in a block mode. It is recommended that approximately 150 hours is required for this course, for satisfactory performance in this program, depending on background and experience. It is the students' responsibility to manage and plan workloads as much as possible to enable a minimum of 8 hours per week.

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

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..

1.4 Attendance

To pass this course it is expected that you will attend 100% of lectures. If you have misadventure or ill-health, please contact your course coordinator as 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 in ground control principles, processes and systems for all stages of mining operations. It will also cover the major ground control design methodologies in use and new developments in leading practice, with the aim of safe and efficient mining operations.

2.2 Learning Outcomes

At the conclusion of this program the student will learn:

1. A practical competence and understanding in all areas presented in course description.
2. Knowledge of ground control practices for mining from feasibility assessment to operations.
3. Principles of effective operational ground control management
4. Understanding of elements of ground control designs.
5. Ground control instrumentation.
6. Application of numerical modelling.

2.3 Graduate Attributes

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

1. The skills involved in scholarly enquiry
2. An in-depth engagement with the relevant disciplinary knowledge in its interdisciplinary context
3. The ability to engage in independent and reflective learning
4. The skills required for collaborative and multidisciplinary work
5. The skills of effective communication

3 REFERENCE RESOURCES

3.1 Reference Materials

- Galvin, J.M. (2016). Ground Engineering Principles and Practices for Underground Coal Mining. Springer International Publishing. ISBN 978-3-319-25003-8. DOI 10.1007/978-3-319-25005-2.
- Bieniawski, Z.T. (1984). Rock mechanics design in mining and tunnelling, A.A. Balkema, Rotterdam.
- Bieniawski, Z.T. (1987). Strata control in mineral engineering, John Wiley and Sons. pp. 29-37.
- Bieniawski, Z.T. (1989). Engineering rock mass classifications. Wiley, NY, 251 pp.
- Brady, B. H. G., and Brown, E. T. (2006). Rock Mechanics for Underground Mining. (Third ed.). Cordrecht: Springer.
- Deep Mines Coal Industry Advisory Committee (DMCIDC), (1996). Guidance on the use of rockbolts to support roadways in coal mines. HSE Books, UK.
- Deep Mines Coal Industry Advisory Committee, Health and Safety Commission. (1996). Guidance on the use of rockbolts to support roadways in coal mines.
- Hoek, E. (2007). Practical Rock Engineering. Rocscience Hoek's corner. http://www.rocscience.com/hoek/Hoek.asp.
- Hoek, E. and Brown, E. T. (1980). Underground excavations in rock. Institution of Mining and Metallurgy.
- Hoek, E., Kaiser, P. K., and Bawden, W. F. (1995). Support of Underground Excavations in Hard Rock. Rotterdam: A.A. Balkema.
- Hutchinson, D. J., and Diederichs, M. S. (1996). Cablebolting in Underground Mines. Richmond, BC: BiTech Publishers.
- Jaeger, J. C., and Cook, N. G. W. (1979). Fundamentals of Rock Mechanics (Third ed.). London: Chapman and Hall.
- Peng, S.S. (1986). Coal mine ground control, 2nd edition, John Wiley and Sons, Inc. U.S.A.
- Van der Merwe, J.N. and Madden, B.J. (2002). Rock engineering for coal mining. Safety in Mines Research Advisory Committee (SIMRAC). SAIMM Special Publications Series 7. April.

During the program other publications and papers will be available in Moodle.

3.2 Other Resources

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

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

3.3 Online Resources

There are many publications are available online. Students are encouraged to review available publications, such as

- Ground Control in Mining Conference Proceedings (University of West Virginia)
- Coal Operators' Conference (University of Wollongong)

4 COURSE CONTENT AND LEARNING ACTIVITIES

4.1 Learning Activities Summary

Presentations and reading material are provided to provide students with technical information and examples of management processes are applied in the mining industry.

Discussions will be used to encourage students to articulate and defend positions, consider different points of view and evaluate evidence. Case studies will be used to provide practice in identifying potential problems and evaluating alternative course of actions.

UNSW Days	Day	Hrs.	Topic	Content/Activities	Presenter
1	15th March	8	Ground control principles and practice	Stiff v soft reinforcement	IC
				Standing support v cables/bolts etc.	
				Tailgate support	
				Rib mechanics v roof mechanics	
				Role of different support hardware elements – how do they work/how efficient and effective are they?	
				Yielding roof bolts for burst control	
				UNSW bolt research – estimation of stress magnitudes from borehole breakouts	Joung Oh.
				Presentations, reading	
2	16th March	8	Modelling of roof bolts and time dependent behaviour	What changes are occurring in support systems/what is needed (related back to rock behaviour mechanisms)?	IC
				UNSW bolt research – laser scanning in underground environment	Simit R
				UNSW bolt research - stress corrosion cracking	Hamed R
				Presentations, reading	
3	17th March	8	Practical ground control case histories	Practical ground control case histories	Dan Payne
				Presentations, reading	IC
4	18th March	8	Practical examples	Practical examples	IC
				Closing remarks and discussion	

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

The range of assessment tasks have been designed to ensure a student can demonstrate they have satisfactorily attained the minimum requirements of the course as defined in the *Learning Outcomes* of the course and *Graduate Attributes* of the program. The student is also advised to review the relevant *Assessment Criteria* before completing each of the assessment items.

Item No.	*Assessment*	*Due Date*	*Weighting*	*Learning outcomes*
A01	**Individual report** – ground support exercise	**11 Apr 11:59pm**	**30%**	**1,2,3,4**
A02	**Individual report** - design methodology and support system selection	**25 Apr 11:59pm**	**35%**	**1,2,3,4,5,6**
A03	**Individual report** – FoS concept in pillar design and support design	**9 May 11:59pm**	**35%**	**1,2,3,4,5,6**

5.2 Assessment Requirements

- All the course materials and assignments will be available online through Moodle. Access to the Moodle site is via the Moodle icon on the MyUNSW homepage, or at https://moodle.telt.unsw.edu.au

When

- As indicated above.
- Early submission is required in cases where the student will otherwise be absent on the due date of submission.

Where

- *Submissions must be made electronically* through Turnitin in 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

- Submission requirements for all assignments are listed in Section 5.
- 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 ***MEA Report Writing Guide for Mining Engineers***. A copy can be obtained from the UNSW Bookshop or downloaded from the School webpage.

How

- The submitted document must be consistent with the following file naming convention: < **FamilyNameInitials_CourseCode_AssignmentNumber.pd**f >.
- A typical complaint filename would take the following form < *SmithPD_2 _A01.pdf* > which elements correspond to:
    - Family name of student: Smith
    - Initial(s) of student: PD
    - Course Code: MINE5050
    - Assignment number: A01...as defined in the Course Outline for the assessment task
    - File format: PDF document

6 ASSESSMENT CRITERIA

The following assessment criteria provide a framework for students when preparing assignments in the course as well as a guideline for assessors when marking an assignment. The student is advised to review the relevant framework before undertaking their assignment.

The criteria listed for each item of assessment and the descriptions contained therein are not intended to be prescriptive nor is it an exhaustive list. Rather it should be viewed as a framework to guide the student as to the type of information and depth of coverage that is expected to be evident in a submission for assessment; the framework illustrates for example what would distinguish an excellent achievement from a poor achievement.

The student should be cognisant that a range of factors is often being assessed in any one assignment; not just whether the final results are numerically correct. Consideration is given to other relevant elements that contribute to the *Learning Outcomes* of the course as well as the *Graduate Attributes* of the overall degree program.

The student is cautioned against merely using the assessment criteria as a checklist. When assessing an assignment, elements in the framework will be examined in terms of quality and creativity. Hence ensuring all the listed elements are merely covered in an assignment is often not sufficient in itself and will not automatically lead to full marks being awarded. Other factors such as how the student went about presenting information, how an argument was structured and/or the elements supporting a particular recommendation or outcome are also important.

Finally the framework can also be used to provide feedback to a student on their performance in an assignment.

6.1 Assignment Reports

The assessment criteria that will be used in assessing the assignment reports is summarised in the following table.

Criteria	Excellent	Good	Satisfactory	Unsatisfactory	Poor	nil
Executive summary / Assignment brief	Executive summary / assignment brief has clearly defined objectives and methodology of the project and includes a comprehensive summary of the findings and outcomes of the project.	Executive summary / assignment brief has defined objectives and methodology of the project and includes some summary of the findings and outcomes of the project.	Executive summary / assignment brief has defined objectives and methodology of the project with minor errors in summary of the findings and outcomes of the project.	Executive summary / assignment brief has some defined objectives and methodology of the project with errors in summary of the findings and outcomes of the project.	Executive summary / assignment brief has poorly defined objectives and methodology with major errors in summary of the findings and outcomes of the project.	Provided no executive summary or assignment brief.
	10 9	8 7	6 5	4 3	2 1	0
Introduction	Introduction provides the reader with a concise background to the topic that is appropriately referenced	Introduction provides the reader with relevant background to the topic	Introduction provides the reader with some background to the topic	Introduction provides the reader with little background to the topic	Introduction provides the reader with very little background to the topic	Introduction missing
	10 9	8 7	6 5	4 3	2 1	0
Methodology adopted	Assignment provides the reader with an excellent and clear description of the methodology and/or any experimental procedure that was used to obtain experimental data	Assignment provides the reader with reasonable description of the methodology and/or any experimental procedure that was used to obtain data	Assignment provides the reader with a brief description of the methodology and/or any experimental procedure that was used to obtain data, which contains minor errors	Assignment provides the reader with a brief description of the methodology and/or any experimental procedure that was used to obtain data, which contains major errors	Assignment provides the reader with a limited description of the methodology and/or any experimental procedure that was used to obtain data	Methodology and/or Experimental Procedures missing
	20 19	18 15	14 10	9 5	4 1	0
Results and discussion	Assignment is supported with appropriate and incisive analysis supported by results with detailed discussion that advances the knowledge of the topic	Assignment is supported with results, analysis and discussion that partially advance the knowledge of the topic	Assignment is supported with some results, analysis and discussion	Assignment has only minimal results and discussion, but analysis is missing	Assignment contains limited results and little discussion of relevance	Results and discussion missing
	40 36	35 28	27 20	19 12	11 1	0
Conclusions	Concise, appropriate and excellent conclusions, clearly demonstrating the significance of the results	Good conclusions, but significance of the results not clearly demonstrated	Reasonable conclusions but significance of the results only partially addressed	Unreasonable conclusions not fully supported by the results in the assignment	Invalid conclusions	Conclusions missing
	10 9	8 7	6 5	4 3	2 1	0
Layout and standard of assignment	• No or few spelling and grammatical errors. References are correctly used and all headings used in the assignment are relevant. • Figures and Tables are correctly formatted, legible and relevant to the content of the assignment	• Some spelling and grammatical errors. References are correctly used and all headings used in the assignment are relevant. • Figures and Tables are correctly formatted, legible and relevant to the content of the assignment, but contain minor errors	• Spelling and grammatical errors to be corrected. • References are used and not all headings used in the assignment are relevant. • Figures and Tables are correctly formatted, legible and relevant to the content of the assignment, but contain some errors	• Major spelling and grammatical errors to be corrected. • Few references are used and many headings used in the assignment are not relevant. • Figures and Tables contain major errors	• Major spelling and grammatical errors to be corrected. • No references are used and many headings used in the assignment are not relevant. • Figures and Tables contain major errors	• Unable to read assignment
	10 9	8 7	6 5	4 3	2 1	0

7 STUDYING A PG COURSE IN UNSW MINERALS AND ENERGY RESOURCES ENGINEERING

7.1 How We Contact You

At times, the School or your course convenors may need to contact you about your course or your enrolment. Your course convenors 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 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
Petroleum Engineering Students: TETB LG34 & LG 35

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.

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.

Late submission will not be accepted and will be considered as no submission.

7.7 Special Consideration

You can apply for special consideration through The Nucleus Student Hub 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:
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

Equitable Learning Services aims to provide all students with a free and confidential service that provides practical support to ensure that your health condition doesn't adversely affect your studies. https://student.unsw.edu.au/els

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: 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.