MIN E 414 Underground Mining Methods

Fall 2024 - September 03 to December 09

Class time: Monday, Wednesday, Friday 10:00-10:50 Location: NRE 2-090

Instructor:

Wei Victor Liu, PhD, P.Eng, he/him

victor.liu@ualberta.ca
Donadeo Innovation Centre For Engineering 6-235
Office Hours: Wednesday, 1:00 PM - 2:00 PM

Course Description:

*3.8 (fi) (first term, 3-0-3/2) Methods and applications in underground excavation and tools to select equipment for underground drilling and loading processes. Methodology to examine shape, size and orientation effects, as well as support requirements, in the design of underground mine opening. Methods include room-and-pillar, sublevel stoping and caving, vertical crater retreat, block caving, selective methods for vein mines, and underground coal mining systems. Labs include software-based design problems dealing with underground mining methods selection, visualization and optimization.

Prerequisites: MIN E 323, MIN E 324 and MIN E 325 or consent of Instructor

Course synchronous and asynchronous content delivery schedule:

Lectures - synchronous; Labs - synchronous

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/ Saulteaux/Anishinaabe, Inuit, and many others whose histories, languages, and cultures continue to influence our vibrant community.

TA Information:

Mr. Jian ZHAO, PhD candidate; Office: DICE 6-244
Email: jian19@ualberta.ca

Lab Sections:

Section	Day	Time	Location
LAB D51	Alternate Fridays	14:00 - 16:50	NRE 2-118

Course Objectives & General Content:

The overall objective of this course is to provide students with an in-depth understanding of various underground mining methods that include mine layout, unit operations, specialized equipment, stability, and safety. In this course, the covered underground mining methods are sublevel stoping, vertical crater retreat mining, raise mining, room-and-pillar mining (hard and soft rock), longwall and shortwall mining, sublevel caving, block caving, cut-and-fill stoping, shrinkage stoping, stull stoping, and resuing stoping. In addition, interactive examples are presented in the class for practical familiarization with the ideas and fundamentals for underground mine design.

Learning Outcomes:

By the end of this course, students should be able to:

1. Sketch simple underground mine layout;
2. Recognize terminologies used in underground mining;
3. Describe and distinguish the concept of various underground mining methods;
4. Rank underground mining methods and select the most appropriate one according to the economics, style of mineralization, and the rock mass classification;
5. Design mine stope, pillar, backfill, and blasting in underground mining
6. Manage one computer software suite assisting the design of underground mining.

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Assignments (6#)	Asynchronous		12%
Lab reports (6#)	Asynchronous		18%
Midterm exam (1#)	Synchronous	October 21, 2024	25%
Final exam (1#)	Synchronous	TBD, see BearTrack	45%

The Faculty recommended grade point average for a 400 level course is 3.1. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Calculator Policy

Approved programmable or approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable programmable calculator (green sticker) or non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Expectations for AI use

On the first day of class, we will as a community co-create an agreement identifying expectations on the use of AI tools that ensures everyone: 1) understands the benefits and limitations of the tools, 2) is able to differentiate between appropriate and inappropriate uses, 3) has equal access to such tools, and 4) is clear on the University of Alberta's relevant policies and procedures.
The Community of Learners agreement will align with the University of Alberta's academic integrity policies and procedures (See relevant section on cheating in University of Alberta (November 2022) Code of Student Behaviour). As necessary, we will agree to revisit and reconsider aspects of the agreement throughout the course to ensure all members of the course's Community of Learners continue to have the required shared understanding of the expectations for AI tool use in this class.
Important: Any and all use of AI and AI tools in assessment tasks must be transparently and honestly identified and referenced as directed. Follow-up reflection assignments explaining AI use must be completed and uploaded to eClass assignments within one (1) day of major assessment task completion.

Text and References (Recommended):

Darling P. SME Underground Mining Handbook. [Electronic Resource]. Society for Mining, Metallurgy & Exploration, Incorporated; 2023. Accessed August 27, 2024. https://search-ebscohost-com.login.ezproxy.library.ualberta.ca/login.aspx?direct=true&db=cat03710a&AN=alb.10448920&site=eds-live&scope=site

Hartman, H. L. and Mutmansky, J. M., (2002), “Introductory mining engineering”, © J. Wiley, Hoboken, N.J., 2nd ed, Pages xii, 570.

Hartman, H.L. (Sr. Editor), (1992), SME Mining Engineering Handbook, Vols. 1 & 2; © Society for Mining, Metallurgy and Exploration, Inc., Littleton, CO.

Hoek, E. and E.T. Brown, (1994), Underground Excavations in Rock; © The Institution of Mining and Metallurgy, London, UK.

Hustrulid, W. A. and Bullock, R. C., (2001), “Underground mining methods: engineering fundamentals and international case studies”, © Society for Mining Metallurgy and Exploration, Littleton, Colo., Pages x, 718.

Gertsch, R. E., Bullock, R. L., and Society for Mining Metallurgy and Exploration (U.S.), (1998), “Techniques in underground mining : selections from Underground mining methods handbook”, © Society for Mining Metallurgy and Exploration, Littleton, CO, Pages ix, 823.

Stewart, D.R. (Editor), (1981), Design and Operation of Caving and Sublevel Stoping Mines; © AIMMPE, New York, N.Y.

Website:

eClass

Lab Information:

Lab Topic	Date
Lab 1: Lab 1: Wireframe design in AEGIS (IRing)	2024-09-20
Lab 2: Lab 2: UG blasting in AEGIS	2024-10-04
Lab 3: Lab 3: Cost and Blast Pattern Analysis	2024-10-18
Lab 4: Lab 4: Learning ARMPS for pillar recovery design	2024-11-01
Lab 5: Lab 5: Introduction to DRIFT for drifting design	2024-11-24
Lab 6: Lab 6: Underground Lab – A comprehensive practice	2024-12-06

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

Tentative Schedule of Lectures and Labs
for
MIN E414: Underground Mining Methods
Instructor: Dr. Wei Victor LIU, P.Eng.; TA: Jian ZHAO, PhD candidate
Lecture Location: NREF 2-090; Lab Location: NREF 2-118 (Cat Lab)

Note: This is only a draft plan subject to revision during the course of the semester.

Week	Date	Lecture Topics	Lab Tutorial Topics	Comments
1	Sep 4, Sep 6	1) Introduction to the course 2) Opening a mineral deposit for mining		
2	Sep 9, Sep 11, Sep 13	3) Overview of underground mining methods - Part 1		Sept 13: HW1 distributed
3	Sep 16, Sep 18, Sep 20	4) Overview of underground mining methods - Part 2 5) UG Mining Methods Selection 6) Introduction to Underground Mine Planning	Sep 20, Lab 1: Wireframe design in AEGIS (IRing)	
4	Sep 23, Sep 25, Sep 27	7) Introduction to Underground Facilities and related Infrastructure 8) Cost Estimating for Underground Mines Open Stope Design - Part 1		Sept 27: HW2 distributed
5	~~Sep 30~~, Oct 2, Oct 4	9) Open Stope Design - Part 2 10) Room and Pillar Coal	Oct 4, Lab 2: UG blasting in AEGIS	Sept 30 (University

Week	Date	Lecture Topics	Lab Tutorial Topics	Comments
		11) Room and Pillar Hard Rock		Closed in honour of Truth and Reconciliation)
6	Oct 7, Oct 9, Oct 11	12) Room and Pillar - Design Basis 13) Longwall mining - Part 1 14) Longwall mining - Part 2		Oct 11: HW3 distributed
7	~~Oct 14~~, Oct 16, Oct 18	15) Shrinkage stoping 16) Mid_Review	Oct 18, Lab 3: Cost and Blast Pattern Analysis in AEGIS	Thanksgiving Day (Oct 14)
8	**Oct 21**, Oct 23, Oct 25	17) **Mid-term exam** 18) Sublevel stoping - Part 1 19) Sublevel stoping - Part 2		**Oct 21, 2024: Mid-Term Exam (Closed Book) (**It covers contents in **first 7 weeks)**
9	Oct 28, Oct 30, Nov 1	20) Sublevel caving - Part 1 21) Sublevel caving - Part 2 22) Sublevel caving - Part 3	Nov 1, Lab 4: Learning ARMPS for pillar recovery design	
10	Nov 4, Nov 6, Nov 8	23) Block caving - Part 1 24) Block caving - Part 2 25) VCR mining		Nov 4: HW4 distributed
11	N/A	N/A		Reading week Remembrance Day

Week	Date	Lecture Topics	Lab Tutorial Topics	Comments
				(Nov 11)
12	Nov 18, Nov 20, Nov 22	26) Cut and Fill mining 27) Resue mining 28) Raise Mining/Alimak Mining	Nov 22, Lab 5: Introduction to DRIFT for drifting design	
13	Nov 25, Nov 27, Nov 29	29) Raise boring 30) Shrinkage stoping 31) Underground solution mining		Nov 29: HW5 distributed
14	Dec 2, Dec 4, Dec 6	32) Shaft sinking 33) Backfill 34) Roof support and safety	Dec 6, Lab 6: Underground Lab – A comprehensive practice	
15	Dec 9	35) Final review		

University and faculty policies

Respect and professionalism

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity

All students are expected to follow the University of Alberta's Student Code of Behaviour and Student Conduct Policy. The faculty expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the Office of Safe Disclosure and Human Rights about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the Code of Ethics set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the University Calendar.

Safety during learning activities

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Code of Behaviour and Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan.

Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.

Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

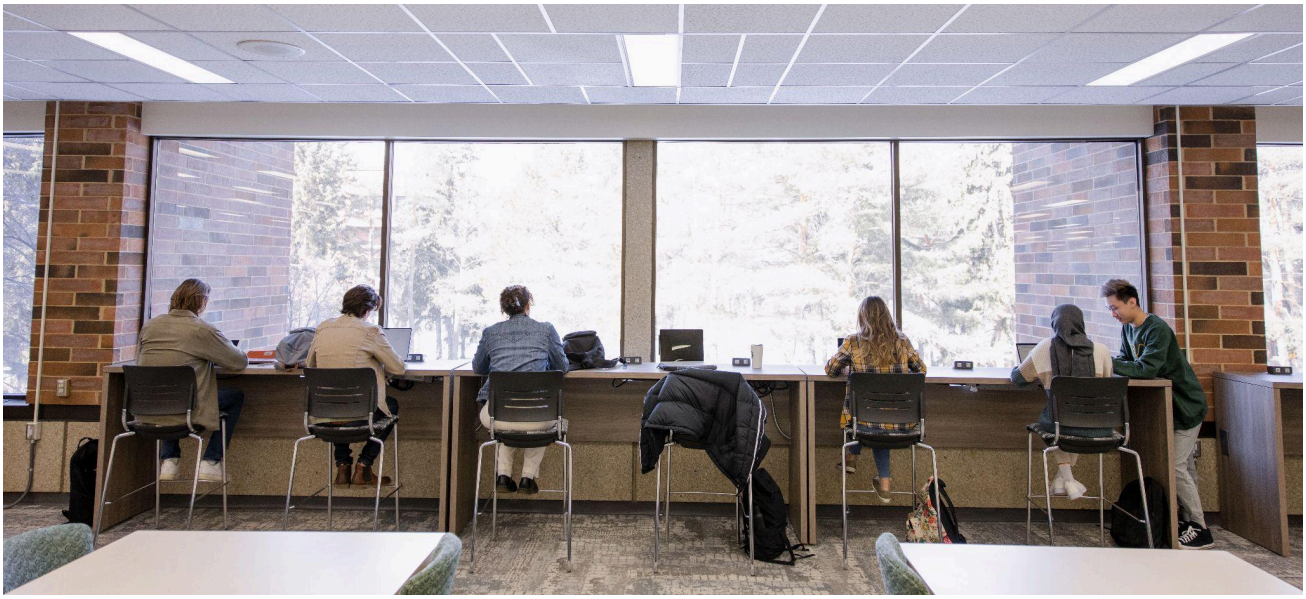
The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support

Academic Success Centre
Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.

Accessibility Resources
Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.

Decima Robinson Support Centre
Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.

Engineering Student Success Centre
The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.

Office of the Student Ombuds
Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.

Financial support

Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.

Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.