Hong Kong University of Science and Technology
Department of Civil and Environmental Engineering

Title of course Instructor Teaching Assistants	**CIVL 4760 Introduction to Rock Mechanics Spring 2022-23** Gang Wang gwang@ust.hk TBA
Course catalog description, Prerequisites Credit	This course introduces basic concepts of rock mechanics applied to geotechnical engineering. Students will learn rock classification, basic mechanical properties of rocks and discontinuities, rock strength and failure criteria, stress-strain analysis in rocks, stability analysis of rock slopes, underground engineering in rocks, and rock foundations. Credit: 3
Textbook(s) and/or Other materials	[1] Lecture notes provided to students before the class; [2] R.E.Goodman, Introduction to Rock Mechanics (2nd Edition). John Wiley & Sons, 1989. HKUST library TA706 .G65 1989 [3] E. Hoek, Practical Rock Engineering, 2007. https://www.rocscience.com/assets/resources/learning/hoek/Practical-Rock-Engineering-Full-Text.pdf [4] B. H. G. Brady and E. T. Brown. Rock Mechanics for Underground Mining, third edition, Springer 2006. Online version available through HKUST library [Link] [5] E. Hoek and J.W. Bray. Rock Slope Engineering, 3rd Edition, Spon Press, 1981 [6] D. C. Wyllie, C. Mah, E. Hoek. Rock **Slope Engineering:** Civil and Mining, *4th Ed.* Taylor & Francis, 2004. Online version available through HKUST library [Link] [7] J.P. Harrison and J.A. Hudson, Engineering Rock Mechanics, An introduction to The Principle, Elsevier Science, 2000. Online version available through HKUST library [Link]
Course objectives	1. Provide students with the fundamental knowledge in physical and mechanical properties of rocks, joints and rock mass classification. 2. Provide students with analytical skills for analyzing rock stresses, rock strength and failure criterion 3. Provide students with analytical skills for the design of rock slopes, underground tunnels and rock foundation.

Topics	1. Basic properties of rocks Geological classification of rocks; Index properties of rock system; Rock mass classification for engineering purpose; Geological/Geotechnical investigation 2. Stress, strain and elasticity Stress and strain tensor; Elasticity; The Mohr circle, failure theory and stress paths 3. Mechanical Properties of Intact rock Laboratory strength test; Stress-strain behavior; Mohr-Coulomb failure criterion; Empirical failure criteria for intact rock 4. Discontinuities and rock mass Tests on discontinuities; Shear strength of joint surface; Properties of rock mass; Stereonet analysis of planar discontinuities 5. Rock slope engineering Plane failure; Wedge failure; Toppling failure; Stereonet analysis of rock slope stability 6. Underground engineering Initial stress in rock mass; Openings in rock – elastic solutions; Techniques for measurement of in-situ stresses; Effect of planes of weakness on elastic stress distribution; Opening in horizontally layered rock; Opening in rock with inclined layers; Elastic-plastic behavior around tunnels; Tunnel support system 7. Rock foundation Types of rock foundations; Allowable bearing pressure in design codes; Elastic solutions of foundation under loads; Failure modes of footing on rocks; Allowable bearing pressure on footings on rocks; Deep foundation in rocks
Class schedule	Lecture: 3 hours/week Tutorial: 50 min/week
Grading policy	Homeworks: 50% Final Exam: 50%
Relationship to Program Objectives	POE1 Provide students with professional skills in the design, construction and management of the civil infrastructure *By taking this course, students are expected to lay down solid foundation in applying analytical skills to solve design problems related to rock slopes, rock tunnels and rock foundation.* POE4 Expose students to real world engineering projects as well as cutting edge research to improve their understanding of the profession and technological advancements that can improve current practice. *The design approach taught in this course reflect the current design practice.*

Relationship to Program Outcomes	PO1.	Understand fundamental principles of engineering science relevant to civil engineering disciplines *This course provides mechanics and mathematics required for stress-strain-strength analysis of rock and discontinuities.*
	PO2.	Acquire an ability to conduct experiments, analyze and interpret results, and appreciate the importance of experimental data in establishing empirical relationships and parameters for analysis and design *The course exposes students with field observation and laboratory data, leading to the development of empirical failure criterion.*
	PO3.	Acquire an ability to apply modern engineering and IT tools effectively and efficiently for engineering analysis, design and communication *Students will learn stereonet analysis, a new tool for understanding rock joints and rock slope stability.*
	PO4.	Develop an ability to identify and formulate civil engineering problems, and propose feasible solutions with an appreciation of their underlying assumptions, uncertainties, constraints, and technical limitations *Many rock engineering problems will be solved in tutorial and homeworks.*
	PO5.	Develop technical competency to design civil engineering components and systems, with an understanding of the principles behind the design methodologies *The course provide necessary technical knowledge for the design of rock slopes, underground tunnels and rock foundation.*
	PO6.	Obtain in-depth knowledge in at least one major area of specialization within civil engineering *After the course, the student is expected to develop strong expertise in rock mechanics and rock engineering.*