

## Fall 2020 Course Descriptions as of 03/30/2020 08:12 PM

Information in Browse Course Catalog is subject to change. Information is term specific. Please refer to the appropriate term when searching for course content. Key to Course Descriptions may be found at: [http://rcs.registrar.arizona.edu/course\\_descriptions\\_key](http://rcs.registrar.arizona.edu/course_descriptions_key).

### Mining Engineering (MNE)

#### **MNE 199: Independent Study** (1 - 4 units)

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Undergraduate

**Course Components:** Independent Study      Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

#### **MNE 201: Nonrenewable Resources and Human Civilizations** (3 - 4 units)

**Description:** The availability and use of nonrenewable resources such as hydrocarbons, coal, metals, stone, and industrial minerals has shaped the development of human societies from the Stone Age to the present, and will continue to affect future humanity. This course explores the uneven natural distribution and varying abundance of nonrenewable resources in the world; how humans have extracted and used them over time; and how nonrenewable resource extraction and use have affected the development of world civilizations. Major themes of this course include resource exhaustion, technological substitution, the geopolitics of resources, and unintended social and environmental side effects of nonrenewable resource extraction and use.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**      Laboratory      May Be Offered  
   Lecture      Required

**Also offered as:** ANTH 201

**Course typically offered:**

Main Campus: Spring

Distance Campus: Spring

**Recommendations and additional information:** Two courses from Tier One, Natural Sciences.

**General Education:** Gen Ed Diversity Emphasis

**General Education:** Tier 2 Natural Sciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**Description:** An introduction to electric circuits in preparation for the FE exam, and the application of electric power systems to mining. The course reviews physical principles applicable to electrical circuits, basic circuit laws and their application to simple DC and AC circuits, including ideal transformers. Three phase circuits and their analysis in simple cases and the electrical characteristics of typical AC and DC motors are studied. This material is then extended to typical mining operations. Particular attention is focused on the relationship between production rates and power usage and associated costs; electrical safety; and common power system terminology with which mining engineers should be conversant.

Main Campus: Spring

**Field trip:** None

Main Campus: Fall, Spring

**Field trip:** Three field trips.

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 210: Mineralogy and Petrology for Engineers** (3 units)

**Description:** A foundation in mineralogy and petrology in an engineering context. The engineering context means that we will place a heavy emphasis on understanding how minerals form, how they are identified, where economically important minerals are found, their uses, how to identify major rock types and understand their basic engineering behavior.

**Grading basis:** Regular Grades

**Career:** Undergraduate

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|---------------------------|------------|----------|
| <b>Course Components:</b> | Laboratory | Required |
|                           | Lecture    | Required |

**Equivalent to:** GEN 210

**Also offered as:** GEN 210

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** CHEM 103A, CHEM 103B, CHEM 104A, CHEM 104B.

**Field trip:** May include 1 or more required field trips.

**MNE 296A: Mineral Resource Engineering Topics** (1 unit)

**Description:** This proseminar provides a first opportunity for undergraduate students to research and exchange information on topics of interest to them in mineral resource engineering. This course will feature industry speakers presenting current challenges or technology innovations in the broad area of mineral resources. Students will further develop their skills in technical writing, project design, and apply their knowledge from general education courses to challenges in the global development of resources

**Grading basis:** Regular Grades

**Career:** Undergraduate

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| <b>Course Components:</b> | Seminar | Required |
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**Course typically offered:**

Main Campus: Fall

**Field trip:** May include 1 or more required field trips

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 297A: Underground Mine Safety (1 unit)**

**Description:** The objective of this course is to provide students the forty (40) hour Mine Safety and Health Administration's required safety training for new underground miners. The course will be taught in accordance with the MSHA approved training plan for the University of Arizona's San Xavier mining laboratory. This course includes training blocks in the statutory rights of miners and their representatives, self-rescuer and respiratory devices, entering and leaving the mine including sign-in/sign-out and tag-in/tag-out procedures, transportation, communications, mine maps, escape ways, emergency evacuation, barricading, roof and ground control, ventilation plans, hazard recognition, electrical hazards, mine gases, health and industrial hygiene issues, first aid and other required subjects.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**      Lecture                                      Required

**Course typically offered:**

Main Campus: Fall, Spring

**Recommendations and additional information:** MNE 205.

**MNE 297B: Operation and Maintenance of Heavy Mining Equipment (1 unit)**

**Description:** This course will provide students the training necessary for the safe operation of complex mining machinery. Students will be trained to correctly and safely operate a mine hoist, diesel air compressor, ventilation fans, Cannon single boom drill jumbo, 3-yard Wagner Load-Haul-Dump (LHD), EIMCO 922 LHD, forklift, backhoe, jackleg drill, overshot mucker and slusher.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**      Lecture                                      Required

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** MNE 205.

**MNE 297C: Fundamentals of Mine Rescue (1 unit)**

**Description:** This course will provide basic training in the rescue procedures to be followed in the event of an accident in an underground mining operation. The students will also learn to operate and maintain the Drager BG-4 self-contained breathing apparatus, the Comspec communications system, mine gas detectors and first aid. This class would also teach the fundamentals of operating an incident command center and fresh air base for underground mine rescue.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**      Lecture                                      Required

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** MNE 205.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 299: Independent Study (1 - 3 units)**

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**MNE 299H: Honors Independent Study (1 - 3 units)**

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Student must be active in the Honors College.

**Honors Course:** Honors Course

**Honors Course:** Honors Course

**MNE 392: Directed Research in Mining Engineering (1 - 6 units)**

**Description:** Individual or small group research under the guidance of faculty.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated for a maximum of 6 units.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering.

**Student Engagement Activity:** Discovery

**Student Engagement Competency:** Innovation and Creativity

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 396A: Technical Trends in Mineral Resource Engineering (1 unit)**

**Description:** This proseminar provides a more advanced opportunity for undergraduate students to research and exchange information on technical topics in mineral resource engineering. The course will feature industry speakers presenting current challenges or technology innovations in the broad area of mineral resources. Students will further develop their skills in technical writing, project design, and apply their knowledge from general education courses to challenges in the global development of resources. Students will develop basic project management skills in anticipation of their senior design project.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Seminar Required

**Course typically offered:**

Main Campus: Spring

**Field trip:** May include 1 or more required field trips

**Enrollment requirement:** Adv Stdg: Engineering.

**Writing Emphasis:** Writing Emphasis Course

**MNE 399: Independent Study (1 - 5 units)**

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**MNE 399H: Honors Independent Study (1 - 3 units)**

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Student must be active in the Honors College.

**Honors Course:** Honors Course

**Honors Course:** Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 402: Probability and Statistical Concepts in Geologic Media** (3 - 4 units)

**Description:** Univariate probabilistic and statistical methods: data reduction, basic probability concepts, discrete and continuous probability distributions, sampling distributions, confidence intervals, goodness-of-fit-tests; applications in geologic media. Introduction to a few statistical packages.

**Grading basis:** Regular Grades

**Career:** Undergraduate

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|---------------------------|------------|----------------|
| <b>Course Components:</b> | Laboratory | May Be Offered |
|                           | Lecture    | Required       |

**Equivalent to:** MNE 402

**Also offered as:** GEN 402

**Co-convened with:** MNE 502

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MATH 223.

**Home department:** Mining & Geological Engineering

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 407: Equipment Operations Technology** (3 units)

**Description:** The course emphasizes the processes of designing, financing, justifying, implementing, operating, and maintaining large-scale earth moving systems. Both fixed and mobile equipment is considered. The course is taught through a combination of lectures, case studies, field trips, practical design projects, industrial interaction and student centered learning. The course focuses on applications in mining, civil, and industrial engineering.

**Grading basis:** Regular Grades

**Career:** Undergraduate

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|---------------------------|---------|----------|
| <b>Course Components:</b> | Lecture | Required |
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**Co-convened with:** MNE 507

**Course typically offered:**

Main Campus: Fall

**Field trip:** Field trips

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 411: Mineral Processing** (3 units)

**Description:** [Taught alternate years beginning Fall 2002] Physical and chemical unit operations used to separate and recover the economic minerals and metals from their ores. The modern scientific and engineering background for the operations are presented as well as economic aspects. Includes field trips to major mining operations in Tucson area.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Equivalent to:** MSE 411

**Also offered as:** MSE 411

**Co-convened with:** MNE 511

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** CHEM 103A, CHEM 103B, CHEM 104A, CHEM 104B or consent of instructor.

**Field trip:** Field trip

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 411L: Mineral Processing Lab** (1 unit)

**Description:** To train the mining engineering students to use the physical ore processing techniques applied in modern mining industry. It covers basic lab techniques, lab safety, sampling, element calculation, sieving test and particle size analysis, grinding test, contact angle measurement, lab flotation test, sedimentation and filtration and solid waste treatment.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Laboratory Required

**Co-convened with:**

**Course typically offered:**

Main Campus: Spring

**Enrollment requirement:** Advanced Standing, College of Engineering; MNE411/511 as prerequisite or co-requisite

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.



**Description:** Methods of excavation of rock in surface and underground mines and construction, ranging from the empiricism of conventional blasting practice to the application of the fundamental mechanics of rock fracture.

**Career:** Undergraduate

**Equivalent to: GEN 415**

**Also offered as: GEN 415**

**Co-convened with: MNE 515**

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** CE 214, prerequisite or concurrent enrollment in CE 215, or instructor consent.

**Field trip:** Field trip

**Enrollment requirement:** Adv Stdg: Engineering.

**Description:** Tailings Storage Facility design (operation) is a multidisciplinary enterprise which requires broad background knowledge in many diverse fields: geotechnical engineering, mining engineering and mineral processing engineering. The responsibility for tailings disposal operation is usually given to mill superintendent or metallurgical engineer, and mining engineers are sometimes confronted with the problems of embankment slope stability and seepage. Thus, it is required for mine operator/engineers to have (preparatory) background knowledge related with Tailings Storage Facility design and operation. This course provides a link between the various technical disciplines. The course includes engineering behavior of tailings, various tailings disposal methods, impoundment water control, and embankment slope stability/seepage analysis using the computational modeling software.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**    Lecture                      Required

**Co-convened with: MNE 517**

**Course typically offered:**

Main Campus: Spring

**Enrollment requirement:** CE 343 or MNE 427. Advanced Standing- College of Engineering.

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 417L: Tailings Lab for Mining Engineers** (1 unit)

**Description:** The recent failure of several tailing dams has led to an increasing need to understand the mechanical properties of tailings materials. This course will cover standard procedures used to test the mechanical properties of tailings materials, including: Moisture content, Specific gravity, Liquid and plastic limit, Particle size analysis by mechanical sieve, One dimensional consolidation test, Small Scale Direct Shear, Large Scale Direct Shear, Standard Proctor test, Sand cone test, Unconfined compressive strength and UU Triaxial test. Meeting times will include a lecture of 30 to 45 minutes to explain testing concepts and procedures.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Laboratory Required

**Co-convened with:** MNE 517L

**Course typically offered:**

Main Campus: Spring

**Field trip:** One field trip to a Commercial Soils Lab.

**Enrollment requirement:** MNE 427 with lab or MNE 527 with lab section.

**MNE 418: Geometallurgy** (3 - 4 units)

**Description:** This course is designed to introduce students to the theory and practice of geometallurgy and the role of mineralogy in mine planning, ore processing, and mine development. Topics include spatial distribution and variability of minerals in ore deposits, mineral behavior and element deportment during ore processing, and industry practices in geometallurgical sampling, testing, materials characterization, and planning. The laboratory section introduces industrial methods of mineral characterization (including SEM, XRD, and MLA) and provides hands-on examination of mineral processing samples from various deposit types.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Laboratory May Be Offered  
Lecture Required

**Also offered as:** GEOS 418

**Co-convened with:** MNE 518

**Course typically offered:**

Main Campus: Spring

**Field trip:** Field trip to Freeport-McMoRan Process Technology Center (Valencia Road, Tucson).

**Enrollment requirement:** Adv Standing: Engineering. (CHEM 152 or MSE 110) and GEOS 251 and GEOS 306.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 419: Mine Planning Software** (1 unit)

**Description:** This course will provide the student with a fundamental understanding of the methodology and process by which mines are designed using modern software tools. Topics covered include compositing drill hole data, creating 3D block models, geologic interpretation, pit limit optimization, and underground models. Course may be taught at an off campus location.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 519

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MNE 205.

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 420: Data Analysis and Application Development for Mining Engineers** (3 units)

**Description:** The purpose of this course is to introduce students to a practical knowledge of programming, specifically, developing scripts to automate data analysis and mine planning tasks. Emphasis is placed on working in the Windows environment. Topics include scripting (CMD, Powershell, Perl, Python), cloud tools (storage, collaboration, CRM, ERP, IAAS), Generic Mapping Tools (GMT), application development on the Windows platform in Matlab and Python, application development on the Android and iOS platforms, social media data mining, spatial and time series data analysis, database creation and manipulation, and web page development. The course provides hands-on experience with practical examples drawn from tasks commonly performed in the mining industry. The course is "lab based", that is, a short presentation followed by hands-on computing exercises on laptops for the remainder of the class period. Homework assignments are designed to develop a working knowledge of a wide range of computing tools.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Repeatable:** Course can be repeated a maximum of 2 times.

**Co-convened with:** MNE 520

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 422: Engineering Sustainable Development** (3 units)

**Description:** This course is for students who wish to learn and engage in modern sustainable development practices with respect to engineering projects that have three areas of impact: economic, environmental and societal. The course will provide background for an understanding of the complexities and inter-relations of sustainable development issues. The focus will be on the minerals development industry, and the impacts in industrialized and developing nations, communities and the environment.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Equivalent to:** ENGR 422

**Also offered as:** ENGR 422

**Co-convened with:** MNE 522

**Course typically offered:**

Main Campus: Fall

**Field trip:** Field trips

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 426: Health and Safety in Mining** (1 unit)

**Description:** Fundamental concepts in the recognition, evaluation and control of health and safety hazards encountered in mining operations; includes a review of engineering management responsibilities to control accidents, a review of federal regulations and standards affecting the industrial workplace, and instruction regarding the interaction of industrial hygiene, safety, fire protection and workers' compensation to control losses resulting from industrial accidents.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Equivalent to:** GEN 426, GEN 426A, MNE 426A

**Also offered as:** GEN 426

**Co-convened with:** MNE 526

**Course typically offered:**

Main Campus: Fall

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 427: Geomechanics** (3 - 4 units)

**Description:** Mechanical behavior of rock and rock masses; response to load changes: deformations, failure, discontinuity slip; in situ stress state; rock testing; geomechanical classifications; engineering applications: slopes, pillars, tunnels, dam foundations; reinforcement design.

**Grading basis:** Regular Grades

**Career:** Undergraduate

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| <b>Course Components:</b> | Laboratory | May Be Offered |
|                           | Lecture    | Required       |

**Equivalent to:** GEN 427

**Also offered as:** GEN 427

**Co-convened with:** MNE 527

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** Prerequisite, CE 214. Corequisite, CE 215 or consent of instructor.

**Field trip:** Course may require one or more field trips.

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 430: Mine Examination and Valuation** (3 units)

**Description:** Principles and procedures in mineral property valuation, geostatistical ore reserve estimation, engineering, economics, investment analysis; use of a microcomputer.

**Grading basis:** Regular Grades

**Career:** Undergraduate

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| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Co-convened with:** MNE 530

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** MNE 205 or consent of instructor.

**Field trip:** course will require 1 or more field trips

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

### **MNE 436: Surface Mine Planning and Design (3 units)**

**Description:** A senior-level course in open pit mine design & planning, incorporating the principles from prior mining and engineering courses. Functions of mine engineering covered include the mine development process, resource and reserve analysis, economic pit limit determination, pit and phase design, production planning, cash flow analyses and social and environmental considerations. Laboratory design problems and work are associated with typical mine design and planning functions, utilizing MineSight software.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with: MNE 536**

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MNE 205, MNE 407, MNE 419 and MNE 427

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 438: Underground Mine Design (2 units)**

**Description:** Understand and apply concepts and problem-solving methods for the design of underground facilities, and operation of underground mines for ores, evaporites, and coal. Topics will include design and layout of excavations, including adits, shafts and slopes, stopes, undercuts and vehicular roadways; mining methods for various geological conditions, sequence of operations (cyclic and continuous), basic design of mine services and equipment selection including ventilation, material-handling, hoisting, electric distribution and dewatering. Safety considerations will be paramount. At the conclusion of the course, participants will be able to select a mining method based on geologic conditions, and perform mine layout, equipment selection and services determination for a target underground production rate.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with: MNE 538**

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MNE 205, 407, 419, 427 and 430, or instructor consent.

**Enrollment requirement:** Adv Stdg: Engineering.

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 439: Surface Chemistry of Flotation** (3 units)

**Description:** The course is to deliver the fundamentals of surface chemistry of flotation in mineral processing. It covers the concepts and principles of the thermodynamics (wetting and adsorption) at the interface, the definition and measurement of surface force in flotation, the DLVO theory and colloid stability, the methods and techniques for surface analysis, and finally the chemistry and mechanism of the chemicals (collector, frother and modifier) applied in flotation.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 539

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MNE 411 or consent of instructor.

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 441: Environmental Management and Mine Reclamation** (3 units)

**Description:** Principles and practices of mine environmental management and reclamation; pre-mining assessment. Design of water management systems (contaminant removal; settling ponds, groundwater protection); recontouring and revegetation; air quality management; noise and seismic mitigation. Maintaining permits; closure and bond release and ultimate land use. Best management practices.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 541

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** CHEM 103B; CHEM 104B; CE 218 or AME 331 or CHEE 203; or consent of instructor.

**Field trip:** 1 or more field trips

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 444: Geopositioning for Mining Applications (3 units)**

**Description:** Geopositioning techniques as applied in the mining industry. Topics cover Global Positioning System (GPS), Photogrammetry, Remote Sensing, Modern Mapping and Scanning Instruments, Geographical Information System (GIS). The materials covered support concepts and topics discussed in other mining courses by allowing the students to collect, process and analyze digital data and use the information to design ventilation system, rock blasting, underground support system, mining sequences, monitor subsidence and slope movements, and simplify the reclamation process. The course is comprised of a lecture period where concepts related to each of the topics listed above will be discussed, and a hands-on portion, which provides the students the opportunity to operate a GPS, motorized total station, and LIDAR scanner in order to acquire data and analyze the collected information using advanced processing software.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**    Lecture                      Required

**Co-convened with: MNE 544**

**Course typically offered:**

Main Campus: Fall

**Recommendations and additional information:** Some knowledge of computer programming

**Field trip:** Field trips are mandatory

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 447: Underground Construction Geomechanics (3 units)**

**Description:** Geomechanical aspects of underground excavation in rock. Empirical and mechanistic stability evaluation and design.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:**

**Co-convened with: MNE 547**

**Course typically offered:**

## Main Campus: Spring

**Recommendations and additional information:** MNE 427 or consent of instructor.

**Field trip:** Course may require 1 or more field trips

**Enrollment requirement:** Adv Stdg: Engineering.

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.



**MNE 450: Elements of Solution Mining** (3 units)

**Description:** This course will provide a basic understanding of fundamental and practical aspects of solution mining.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Repeatable:** Course can be repeated a maximum of 3 times.

**Co-convened with:** MNE 550

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** MNE 205, MNE 210 or CHEE 201 or MSE 222

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 465: Hydrometallurgy** (3 units)

**Description:** This course will provide the student with a basic understanding of fundamental and practical aspects of hydrometallurgy processes used to extract and recover mineral and metal values. Unit processes where aqueous solutions play a major role will be examined in detail. The course will focus on the basic processes of leaching, solution concentration and purification, and metal recovery.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 565

**Course typically offered:**

Main Campus: Fall

**Enrollment requirement:** Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 475: Biotechnology and Extractive Metallurgy (3 units)**

**Description:** The course is to deliver the fundamental microbiology and its application for metal extraction and sulfide oxidation. It covers general biooxidation and bioleaching of sulfide minerals and metal extractions principles and laboratory methods. It includes the mechanism of bioleaching and biooxidation, the different strains of microorganisms, and metallurgical testing methods. The course also provide the key parameters to design a batch reactor, a column testwork, and industrial heap practice. Case study of different operation will also be discussed.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Co-convened with: MNE 575**

**Course typically offered:**

Main Campus: Spring

**Field trip:** One field trip to Freeport McMoRan's Morenci bioleaching operation and one field trip to Universal Bio Mining Laboratory in Tucson will be scheduled.

**Enrollment requirement:** Advanced Standing - Engineering. CHEM 152 or MSE 110.

**MNE 476: Mine Ventilation** (4 units)

**Description:** The purpose of this course is to introduce mining engineering students to the principles, applications, analysis, and design of subsurface ventilation systems. Topics covered include: thermodynamics properties of air, ventilation planning, design, survey, and network analysis, fan types, impeller theory, fan laws, and ventilation (fan) economics, mine heat, gases and dust, governing regulations and environmental consideration. Computer applications, laboratory work and intensive field trip further enhance the understanding of the fundamental concepts.

**Grading basis:** Regular Grades

**Career:** Undergraduate

|                           |         |          |
|---------------------------|---------|----------|
| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Co-convened with: MNE 576**

**Course typically offered:**

Main Campus: Spring

**Recommendations and additional information:** CE 218. Computer skills: Microsoft Office, basic CAD & ability to learn and work with engineering software Engineering skills: Basic knowledge of mining, thermodynamics & calculus.

**Enrollment requirement:** Adv Stdg: Engineering.

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 484: Fundamentals of Industrial and Environmental Health** (3 units)

**Description:** Introduction to the principles of occupational and environmental health, with emphasis on industrial hygiene aspects of recognition, evaluation, and control of environmental and industrial health hazards.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Lecture Required

**Equivalent to:** CE 484, MNE 484, OSH 484, PCOL 484, PHL 484

**Also offered as:** EHS 484, NSC 484, PCOL 484

**Course typically offered:**

Main Campus: Fall

**Home department:** Community, Environment & Pol

**MNE 492: Directed Research in Mining Engineering** (1 - 6 units)

**Description:** Individual or small group research under the guidance of faculty

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated for a maximum of 6 units.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering.

**Student Engagement Activity:** Discovery

**Student Engagement Competency:** Innovation and Creativity

**MNE 493: Internship** (1 - 3 units)

**Description:** Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment. Related to Mining and Geological Engineers.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated for a maximum of 9 units.

**Co-convened with:** MNE 593

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering.

**Student Engagement Activity:** Professional Development

**Student Engagement Competency:** Professionalism

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 498: Senior Capstone** (1 - 2 units)

**Description:** Students work in teams to solve substantive real-world design problems in their academic discipline. The class is normally taken over two semesters, and involves teaming, ethics, innovative experiment or prototype design and construction, testing, evaluation, and optimization. Final designs are presented to a panel of professional engineers for judging. The final designs are documented in writing including project scheduling, management, and budgets. Students are to enroll in 1 unit MAX fall semester AND 2 units MINIMUM the following spring semester for 3 units total.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study      Required

**Repeatable:** Course can be repeated for a maximum of 3 units.

**Course typically offered:**

Main Campus: Fall, Spring

**Recommendations and additional information:** Must have completed both MNE 436 and MNE 438.

**Enrollment requirement:** Adv Stdg: Engineering.

**Student Engagement Activity:** Discovery

**Student Engagement Competency:** Innovation and Creativity

**MNE 498H: Honors Thesis** (3 units)

**Description:** An honors thesis is required of all the students graduating with honors. Students ordinarily sign up for this course as a two-semester sequence. The first semester the student performs research under the supervision of a faculty member; the second semester the student writes an honors thesis.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study      Required

**Repeatable:** Course can be repeated for a maximum of 9 units.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering. Honors active.

**Honors Course:** Honors Course

**Honors Course:** Honors Course

**Student Engagement Activity:** Discovery

**Student Engagement Competency:** Innovation and Creativity

**Writing Emphasis:** Writing Emphasis Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 499: Independent Study** (1 - 3 units)

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering.

**MNE 499H: Honors Independent Study** (3 units)

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work.

**Grading basis:** Regular Grades

**Career:** Undergraduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

**Enrollment requirement:** Adv Stdg: Engineering. Honors active.

**Honors Course:** Honors Course

**Honors Course:** Honors Course

**MNE 503: Technical Leadership for Engineers** (1 unit)

**Description:** This course introduces the concepts of technical leadership in today's modern engineering profession. The increasing complexity of advanced technologies and systems requires a new generation of technical leaders who are creative, independent, and innovative to think, understand and solve complex problems from multiple engineering perspectives. This senior level course leverages the principles of systems engineering by applying a "systems thinking" approach to solving complex industrial problems in today's continuous challenging technical environments. This course examines the critical roles and functions of leadership and management for technical engineers. Topics include leadership by example, professional ethics, creating and developing effective teams, relationship building, influencing, and leading and managing change through creativity and innovation. This course also analyzes leadership attributes as a means to understand what makes a successful or failed leader. There will be assigned case studies that analyze these attributes.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Also offered as:** SIE 503

**Course typically offered:**

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 504B: Lowell Program Topics in Ore Deposits Mapping (1 unit)**

**Description:** This intensive course deals with methods in ore deposits mapping. It includes lectures and field trips, highlighting how geologic mapping is used to understand mineral zoning, time-space relations, and fundamental phase equilibria. Graduate-level requirements include additional reading material worth 20% of grade.

**Grading basis:** Regular Grades

**Career:** Graduate

|                           |            |                |
|---------------------------|------------|----------------|
| <b>Course Components:</b> | Laboratory | Required       |
|                           | Lecture    | May Be Offered |

**Repeatable:** Course can be repeated for a maximum of 3 units.

**Equivalent to:** MNE 504B

**Also offered as:** GEOS 504B

**Co-convened with:** MNE 404B

**Field trip:** Field trips.

**Home department:** Geosciences

**MNE 504C: Lowell Program Topics in Mineral Deposit Types (1 unit)**

**Description:** This intensive course covers the geology of selected types of mineral deposits, including their lithologic, structural, and geochemical features and applications to mineral exploration. The course includes lectures, laboratory exercises, and field trips to selected ore systems. Graduate-level requirements include more extensive reading and discussions during the course for 20% of grade.

**Grading basis:** Regular Grades

**Career:** Graduate

|                           |            |                |
|---------------------------|------------|----------------|
| <b>Course Components:</b> | Laboratory | May Be Offered |
|                           | Lecture    | Required       |

**Repeatable:** Course can be repeated for a maximum of 3 units.

**Equivalent to:** MNE 504C

**Also offered as:** GEOS 504C

**Co-convened with:** MNE 404C

**Field trip:** Field trips.

**Home department:** Geosciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 507: Equipment Operations Technology** (3 units)

**Description:** The course emphasizes the processes of designing, financing, justifying, implementing, operating, and maintaining large-scale earth moving systems. Both fixed and mobile equipment is considered. The course is taught through a combination of lectures, case studies, field trips, practical design projects, industrial interaction and student centered learning. The course focuses on applications in mining, civil, and industrial engineering. Graduate-level requirement includes individual graduate project.

**Grading basis:** Regular Grades

**Career:** Graduate

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|---------------------------|---------|----------|
| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Co-convened with: MNE 407**

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

### Field trip: Field trips

**MNE 510A: Mineral Properties Engineering** (2 units)

**Description:** A thorough background in mineralogy, mineral chemistry, and mineral properties is essential to a study of mineral processing, geometallurgy, and mine planning as well as to understanding environmental and public health issues related to mining and earth resources. This course provides an application-oriented introduction to the structures, chemical makeup, and physical and chemical properties of minerals, with particular emphasis on the properties relevant to mining and geological engineering. It is designed to reinforce knowledge gained in basic mineralogy courses and to supplement it with a deeper and broader understanding of the origins and applications of specific mineral properties used in industry today, as preparation for MNE/GEOS 418/518 (Geometallurgy). The laboratory section introduces hands-on mineral identification techniques ranging from hand sample identification to optical and energy microscopy. Graduate level requirements include an in-class presentation of a research project.

**Grading basis:** Regular Grades

**Career:** Graduate

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|---------------------------|------------|----------|
| <b>Course Components:</b> | Laboratory | Required |
|                           | Lecture    | Required |

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 511: Mineral Processing** (3 units)

**Description:** [Taught alternate years beginning Fall 2002] Physical and chemical unit operations used to separate and recover the economic minerals and metals from their ores. The modern scientific and engineering background for the operations are presented as well as economic aspects. Includes field trips to major mining operations in Tucson area. Graduate-level requirements include an advanced research project.

**Grading basis:** Regular Grades

**Career:** Graduate

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| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Equivalent to: MSE 511**

**Also offered as: MSE 511**

**Co-convened with: MNE 411**

**Course typically offered:**

Main Campus: Fall

## Online Campus: Fall

**Recommendations and additional information:** Knowledge of chemistry or consent of instructor.

### Field trip: Field trips

**MNE 511L: Mineral Processing Lab (1 unit)**

**Description:** To train the mining engineering students to use the physical ore processing techniques applied in modern mining industry. It covers basic lab techniques, lab safety, sampling, element calculation, sieving test and particle size analysis, grinding test, contact angle measurement, lab flotation test, sedimentation and filtration and solid waste treatment.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Laboratory Required

**Co-convened with: MNE 411L**

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Enrollment requirement:** MNE 511 as prerequisite or co-requisite

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.



**MNE 515: Rock Excavation** (3 units)

**Description:** Methods of excavation of rock in surface and underground mines and construction, ranging from the empiricism of conventional blasting practice to the application of the fundamental mechanics of rock fracture. Graduate-level requirements include a research project.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Equivalent to:** GEN 515

**Also offered as:** GEN 515

**Co-convened with:** MNE 415

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Recommendations and additional information:** Knowledge of rock mechanics or consent of instructor.

**Field trip:** Field trip

**MNE 517: Tailings Storage Facility Design (Planning, Design and Analysis)** (3 units)

**Description:** Tailings Storage Facility design (operation) is a multidisciplinary enterprise which requires broad background knowledge in many diverse fields: geotechnical engineering, mining engineering and mineral processing engineering. The responsibility for tailings disposal operation is usually given to mill superintendent or metallurgical engineer, and mining engineers are sometimes confronted with the problems of embankment slope stability and seepage. Thus, it is required for mine operator/engineers to have (preparatory) background knowledge related with Tailings Storage Facility design and operation. This course provides a link between the various technical disciplines. The course includes engineering behavior of tailings, various tailings disposal methods, impoundment water control, and embankment slope stability/seepage analysis using the computational modeling software. Graduate level students will have additional assignments and projects (presentations and technical reports) assigned.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 417

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 517L: Tailings Lab for Mining Engineers** (1 unit)

**Description:** The recent failure of several tailing dams has led to an increasing need to understand the mechanical properties of tailings materials. This course will cover standard procedures used to test the mechanical properties of tailings materials, including: Moisture content, Specific gravity, Liquid and plastic limit, Particle size analysis by mechanical sieve, One dimensional consolidation test, Small Scale Direct Shear, Large Scale Direct Shear, Standard Proctor test, Sand cone test, Unconfined compressive strength and UU Triaxial test. Meeting times will include a lecture of 30 to 45 minutes to explain testing concepts and procedures.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**    Laboratory                      Required

**Co-convened with:** MNE 417L

**Course typically offered:**

Main Campus: Spring

**Field trip:** One trip to a Commercial Soils Lab.

**Enrollment requirement:** MNE 427 with lab or MNE 527 with lab section.

**MNE 518: Geometallurgy** (4 units)

**Description:** This course is designed to introduce students to the theory and practice of geometallurgy and the role of mineralogy in mine planning, ore processing, and mine development. Topics include spatial distribution and variability of minerals in ore deposits, mineral behavior and element deportment during ore processing, and industry practices in geometallurgical sampling, testing, materials characterization, and planning. The laboratory section introduces industrial methods of mineral characterization (including SEM, XRD, and MLA) and provides hands-on examination of mineral processing samples from various deposit types.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**    Laboratory                      Required  
   Lecture                              Required

**Also offered as:** GEOS 518

**Co-convened with:** MNE 418

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Field trip:** Freeport-McMoRan Process Technology Center (Valencia Road, Tucson)

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**Description:** This course will provide the student with a fundamental understanding of the methodology and process by which mines are designed using modern software tools. Topics covered include compositing drill hole data, creating 3D block models, geologic interpretation, pit limit optimization, and underground models. Course may be taught at an off campus location. Graduate-level requirements include a more in-depth work in the area of 3-D block models, interpolation, and constraints on mine design. Grading percentages will remain the same but more extensive homework and projects will be assigned.

Online Campus: Spring

Online Campus: Fall, Spring

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**Description:** This course is for students who wish to learn and engage in modern sustainable development practices with respect to engineering projects that have three areas of impact: economic, environmental and societal. The course will provide background for an understanding of the complexities and inter-relations of sustainable development issues. The focus will be on the minerals development industry, and the impacts in industrialized and developing nations, communities and the environment. Graduate-level requirements include project management duties, where graduate students are expected to manage groups of undergraduates in the design of the final term project. Additional graduate projects and assignments will have requirements for type and quantity of work.

**Career:** Graduate

**Equivalent to: ENGR 522**

**Also offered as: ENGR 522**

**Co-convended with: MNE 422**

**Course typically offered:**

Main Campus: Fall

## Online Campus: Fall

### Field trip: Field trips

**Description:** Fundamental concepts in the recognition, evaluation and control of health and safety hazards encountered in mining operations; includes a review of engineering management responsibilities to control accidents, a review of federal regulations and standards affecting the industrial workplace, and instruction regarding the interaction of industrial hygiene, safety, fire protection and workers' compensation to control losses resulting from industrial accidents. Graduate-level requirements include a term paper.

**Career:** Graduate

**Equivalent to: GEN 526**

**Also offered as: GEN 526**

**Co-convened with: MNE 426**

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 527: Geomechanics** (3 - 4 units)

**Description:** Mechanical behavior of rock and rock masses; response to load changes: deformations, failure, discontinuity slip; in situ stress state; rock testing; geomechanical classifications; engineering applications: slopes, pillars, tunnels, dam foundations; reinforcement design. Graduate-level requirements include either a research project or a research paper at the discretion of the instructor.

**Grading basis:** Regular Grades

**Career:** Graduate

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|---------------------------|------------|----------------|
| <b>Course Components:</b> | Laboratory | May Be Offered |
|                           | Lecture    | Required       |

**Equivalent to:** GEN 527

**Also offered as:** GEN 527

**Co-convened with:** MNE 427

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Recommendations and additional information:** Knowledge of mechanics of materials or consent of instructor.

**Field trip:** Course may require one or more field trips.

**MNE 529: Rock Slope Analyses and Design** (3 units)

**Description:** Geologic and engineering considerations in design of optimum rock slope angles; constitutive models for intact rock and joints; theoretical stability analysis, monitoring and control of existing slopes.

**Grading basis:** Regular Grades

**Career:** Graduate

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| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Equivalent to:** GEN 529

**Also offered as:** GEN 529

**Course typically offered:**

Main Campus: Fall

**Field trip:** Field trip.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 530: Mine Examination and Valuation** (3 units)

**Description:** Principles and procedures in mineral property valuation, geostatistical ore reserve estimation, engineering, economics, investment analysis; use of a microcomputer. Graduate-level requirements include either a research project or a research paper at the discretion of the instructor.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 430

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Field trip:** Course will require 1 or more field trips

**MNE 536: Surface Mine Planning and Design** (3 units)

**Description:** A senior-level course in open pit mine design & planning, incorporating the principles from prior mining and engineering courses. Functions of mine engineering covered include the mine development process, resource and reserve analysis, economic pit limit determination, pit and phase design, production planning, cash flow analyses and social and environmental considerations. Laboratory design problems and work are associated with typical mine design and planning functions, utilizing MineSight software. Graduate-level requirements include an additional project.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 436

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Recommendations and additional information:** Knowledge of mining methods and equipment or consent of instructor is recommended for this course.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**Description:** Understand and apply concepts and problem-solving methods for the design of underground facilities, and operation of underground mines for ores, evaporites, and coal. Topics will include design and layout of excavations, including adits, shafts and slopes, stopes, undercuts and vehicular roadways; mining methods for various geological conditions, sequence of operations (cyclic and continuous), basic design of mine services and equipment selection including ventilation, material-handling, hoisting, electric distribution and dewatering. Safety considerations will be paramount. At the conclusion of the course, participants will be able to select a mining method based on geologic conditions, and perform mine layout, equipment selection and services determination for a target underground production rate. Graduate-level requirements include a Critical Topic Analysis worth 15% of grade.

**Career:** Graduate

**Co-convened with: MNE 438**

**Course typically offered:**

**Main Campus: Spring**

Online Campus: Spring

**MNE 539: Surface Chemistry of Flotation** (3 units)

**Description:** The course is to deliver the fundamentals of surface chemistry of flotation in mineral processing. It covers the concepts and principles of the thermodynamics (wetting and adsorption) at the interface, the definition and measurement of surface force in flotation, the DLVO theory and colloid stability, the methods and techniques for surface analysis, and finally the chemistry and mechanism of the chemicals (collector, frother and modifier) applied in flotation. Graduate-level requirements include deriving and defining some fundamentals and principles; review applications of chemicals and surface chemistry in flotation; propose possible methods and solve practical problems.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**    Lecture                  Required

**Co-convened with: MNE 439**

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Recommendations and additional information:** MNE 411 or consent of instructor.

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 541: Environmental Management and Mine Reclamation** (3 units)

**Description:** Principles and practices of mine environmental management and reclamation; pre-mining assessment. Design of water management systems (contaminant removal; settling ponds, groundwater protection); recontouring and revegetation; air quality management; noise and seismic mitigation. Maintaining permits; closure and bond release and ultimate land use. Best management practices. Graduate-level requirements include additional assignments and a research paper or presentation on a specific environmental management topic.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Co-convened with:** MNE 441

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Field trip:** 1 or more field trips

**MNE 543C: Geologic Best Practices and Project Stages** (3 units)

**Description:** This course introduces communication and leadership terminology as applied to project management in mineral exploration and mining, then examines the stages through which projects advance and how best practices in geology are achieved at the various stages.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Equivalent to:** MNE 543C

**Also offered as:** GEOS 543C

**Field trip:** Course includes field trips.

**Home department:** Geosciences

**MNE 543D: Sustainable Development and Mineral Resources** (2 units)

**Description:** This survey course covers the breadth of mineral resources development from both mining and non-mining perspectives. The course is intended to provide a broad, interdisciplinary overview of topics for graduate students interested in mineral resources topics who wish to learn more about the scope, current issues and future challenges.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Repeatable:** Course can be repeated a maximum of 3 times.

**Also offered as:** GEOS 543D

**Field trip:** One or two day-long field trips to relevant areas in southern Arizona.

**Home department:** Geosciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.



**MNE 544: Geopositioning for Mining Applications (3 units)**

**Description:** Geopositioning techniques as applied in the mining industry. Topics cover Global Positioning System (GPS), Photogrammetry, Remote Sensing, Modern Mapping and Scanning Instruments, Geographical Information System (GIS). The materials covered support concepts and topics discussed in other mining courses by allowing the students to collect, process and analyze digital data and use the information to design ventilation system, rock blasting, underground support system, mining sequences, monitor subsidence and slope movements, and simplify the reclamation process. The course is comprised of a lecture period where concepts related to each of the topics listed above will be discussed, and a hands-on portion, which provides the students the opportunity to operate a GPS, motorized total station, and LIDAR scanner in order to acquire data and analyze the collected information using advanced processing software. Graduate-level requirements include additional term project with a wider and more detailed scope of work, and advanced data analysis and interpretation.

**Grading basis:** Regular Grades

**Career:** Graduate

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|---------------------------|---------|----------|
| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Co-convener with: MNE 444**

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Recommendations and additional information:** Some knowledge of computer programming

**Field trip:** Field trips are mandatory

**MNE 547: Underground Construction Geomechanics (3 units)**

**Description:** Geomechanical aspects of underground excavation in rock. Empirical and mechanistic stability evaluation and design. Graduate-level requirements include an independent design/analysis project.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**    Lecture                      Required

**Co-convened with: MNE 447**

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Recommendations and additional information:** Knowledge of geomechanics or consent of instructor.

**Field trip:** Course may require 1 or more field trips

**-SA** represents a Student Abroad & Student Exchange offering

**-CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 550: Elements of Solution Mining** (3 units)

**Description:** This course will provide a basic understanding of fundamental and practical aspects of solution mining. Graduate-level requirements include more rigorous and analytical homework.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Repeatable:** Course can be repeated a maximum of 3 times.

**Co-convened with:** MNE 450

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**MNE 560A: Ore Deposits and Mine Operations** (3 units)

**Description:** MNE 560A covers an overview of the mining process, including the initial steps to define a geological orebody of economic interest, the procedure to acquire basic knowledge of the deposit's physical and economic characteristics, and the approach to develop a mine following existing extraction methods. Additional topics covered include mining terminology and decision making based on the operating conditions, equipment requirements, and work flow of the entire production process; mineral processing techniques according to the type of mineral found in the deposit; and the essential laws and procedures for mine closing and reclamation.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Course typically offered:** Online Campus: Fall

Distance Campus: Fall

**MNE 560B: Mine Economics, Optimization, and Reclamation** (3 units)

**Description:** MNE 560B covers engineering economics fundamentals and its application in obtaining the value of a mining project, from its inception to project execution, finalizing with the mine closeout. Essential concepts in mine valuation, including the value of money in time, economic decisions based on interest rates, capital cost, expenditures, discount rates, cash flow and other financial tools are covered. Additional topics covered include fleet management, equipment operations, data utilization, energy, new technologies, tailings disposal and reclamation.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Course typically offered:** Online Campus: Spring

Distance Campus: Spring

**Enrollment requirement:** MNE 560A.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 565: Hydrometallurgy** (3 units)

**Description:** This course will provide the student with a basic understanding of fundamental and practical aspects of hydrometallurgy processes used to extract and recover mineral and metal values. Unit processes where aqueous solutions play a major role will be examined in detail. The course will focus on the basic processes of leaching, solution concentration and purification, and metal recovery. Graduate-level requirements include a separate exam that will require more rigor & analysis. In addition, all students will be assigned a semester project & oral presentation covering a thematic area of hydrometallurgy of current interest.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**    Lecture                      Required

**Co-convened with: MNE 465**

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**MNE 575: Biotechnology and Extractive Metallurgy (3 units)**

**Description:** The course is to deliver the fundamental microbiology and its application for metal extraction and sulfide oxidation. It covers general biooxidation and bioleaching of sulfide minerals and metal extractions principles and laboratory methods. It includes the mechanism of bioleaching and biooxidation, the different strains of microorganisms, and metallurgical testing methods. The course also provide the key parameters to design a batch reactor, a column testwork, and industrial heap practice. Case study of different operation will also be discussed. Graduate level requirements include additional questions in the exam that require more rigor & analysis and a semester-long project and report.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Co-convened with: MNE 475**

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Field trip:** One field trip to Freeport McMoRan's Morenci bioleaching operation and one field trip to Universal Bio Mining Laboratory in Tucson will be scheduled.

**-SA** represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

## MNE 576: Mine Ventilation (4 units)

**Description:** The purpose of this course is to introduce mining engineering students to the principles, applications, analysis, and design of subsurface ventilation systems. Topics covered include: thermodynamics properties of air, ventilation planning, design, survey, and network analysis, fan types, impeller theory, fan laws, and ventilation (fan) economics, mine heat, gases and dust, governing regulations and environmental consideration. Computer applications, laboratory work and intensive field trip further enhance the understanding of the fundamental concepts. Graduate-level requirement include a research project.

**Grading basis:** Regular Grades

**Career:** Graduate

|                           |         |          |
|---------------------------|---------|----------|
| <b>Course Components:</b> | Lecture | Required |
|---------------------------|---------|----------|

**Co-convener with: MNE 476**

**Course typically offered:**

Main Campus: Spring

Online Campus: Spring

**Recommendations and additional information:** Computer skills: Microsoft Office, basic CAD & ability to learn and work with engineering software Engineering skills: Basic knowledge of mining, thermodynamics & calculus.

**MNE 580: The Mechanics of Fracture in Rock and Other Brittle Materials (3 units)**

**Description:** Fracture mechanics theory applied to the deformation and failure of rock; numerical techniques; micromechanical damage models; flow through fractures; the mechanics of faulting and earthquake rupture.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Lecture Required

**Equivalent to: GEN 580**

**Also offered as: GEN 580**

**Course typically offered:**

Main Campus: Spring (odd years only)

Online Campus: Spring (odd years only)

**Field trip:** Course may include 1 or more field trips.

**-SA** represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 590: Remote Sensing for the Study of Planet Earth (3 units)**

**Description:** Remote Sensing for the Study of Planet Earth introduces basic and applied remote sensing science as a means to explore the diversity of our planetary environments (biosphere, atmosphere, lithosphere and hydrosphere) within the radiometric, spectral, spatial, angular and temporal domains of remote sensing systems. This survey course strikes a balance between theory, applications and hands-on labs and assignments. We explore how you can download, process, analyze and interpret multi-sensor data and integrate online remotely sensed data sources/products into your research of interest.

**Grading basis:** Regular Grades

**Career:** Graduate

**Flat Fee:** \$50

**Course Components:** Lecture Required

**Equivalent to:** ARL 590, ARL 590, ATMO 590, GEN 590, GEOG 590, GEOS 590, HWRS 590, MNE 590, OPTI 590, RNR 590, SW 590, SWES 590

**Also offered as:** ARL 590, ATMO 590, ENVS 590, GEOG 590, GEOS 590, HWRS 590, OPTI 590, REM 590, RNR 590

**Co-convened with:**

**Course typically offered:**

Main Campus: Fall

**Home department:** GIDP on Remote Sensing and Spatial Analysis

**MNE 593: Internship (1 - 3 units)**

**Description:** Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment. Related to Mining and Geological Engineers.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated for a maximum of 9 units.

**Co-convened with:** MNE 493

**Course typically offered:**

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 597A: Introduction to Fleet Management Systems (1 unit)**

**Description:** This course is designed for frontline technical personnel (engineers), experienced graduate students, mid-level managers, and process improvement technologists who are currently engaged in the investment and utilization of modern information technology (IT) for mines such as Fleet Management systems (FMS). The course may be opened to senior-level undergraduates who meet the prerequisites to take masters-level courses and with permission from the instructor. The course introduces students to the use, application and value of using FMS in mines. The hands-on system used is the Cat® MineStar<sup>®</sup> Fleet system applied to surface mining operations. Students will participate during the lecture and in the computer lab by using Fleet client software to understand how an FMS system improves efficiency, provides safer mining environments, optimize production, minimize operational cost, provide KPI management, and monitor machine health.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**Recommendations and additional information:** MNE 507.

**MNE 598: Mining Capstone Project (3 units)**

**Description:** MNE 598 utilizes the concepts and skills developed from 560A and 560B to prepare a feasibility study for a complete mining project, or a specific aspect of a mining project such as a mine expansion. The feasibility study covers the whole projected life of the mine or part of the mine, including assessing its technical viability and economic feasibility. Equipment selection and decision choices are required elements of the feasibility study for achieving critical operating conditions that have to be made for reaching production, safety and economic goals. Environmental and safety considerations are also key elements for a successful project completion. Students will complete the feasibility study and present the project orally and in a technical report.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Independent Study Required

**Enrollment requirement:** MNE 560B.

**MNE 599: Independent Study (1 - 3 units)**

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 641: Water Law** (3 units)

**Description:** The course in Water Law traditionally emphasizes state law rules that govern rights to use surface water and groundwater throughout the country. Although we will give ample attention to the prior appropriation doctrine, riparian water rights, and various systems for regulating groundwater use, this course will also emphasize how federal law may impact water rights. Increasingly, environmentalists and others claim that there are public rights to water that may take precedence over rights under the prior appropriation system.

**Grading basis:** Alternative Grading: ABCDE/SP

**Career:** Graduate

**Course Components:**      Lecture                                      Required

**Also offered as:** ENVS 641, GEOG 641, HWRS 641, LAW 641

**Course typically offered:**

Main Campus: Spring

**Home department:** Law

**MNE 670: Applied Earth Science Measurement and Imaging** (3 units)

**Description:** Applied Earth Science measurements, data processing, and Imaging in an engineering context with heavy emphasis on understanding practical aspects of problem solving, and data collection design and field implementation. Methods and applications of multiply types of data collection systems as well as the associated data processing, imaging and interpretation of the data as pertaining to the needs of a project will be covered.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:**      Lecture                                      Required

**Course typically offered:**

Main Campus: Fall

Online Campus: Fall

**Recommendations and additional information:** Some knowledge of computer programming.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 696A: Research Seminar (1 - 3 units)**

**Description:** This graduate seminar provides graduate students the opportunity to research and exchange information on technical topics in the mine life cycle. The course will feature industry speakers presenting current challenges or technology innovations in the broad area of mineral resources. Students will further develop their skills in technical writing, learn to communicate with a professional audience, learn skills to influence others, and gain a basic knowledge of the business and socioeconomic principles that impact the profession.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Seminar Required

**Repeatable:** Course can be repeated for a maximum of 6 units.

**Equivalent to:** GEN 696A, MNEC 696A

**Also offered as:** GEN 696A

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

**MNE 696B: Modern Mining Information Systems (1 - 3 units)**

**Description:** This course is designed for frontline technical personnel (engineers), experienced graduate students, mid-level managers, and process improvement technologists who are currently engaged in the investment and utilization of modern information technology (IT) for mines such as Fleet Management systems, drill monitoring, maintenance, performance monitoring, and Enterprise Systems.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Seminar Required

**MNE 696C: Topics in Mine Environment Management (1 - 2 units)**

**Description:** Topics in state of the art and practice for mine reclamation and environmental management of mine sites will be discussed from current literature. Students will gain an understanding of mining operations and the environmental impacts of the mine that need to be managed. Students will integrate readings in soil science, geology, hydrology, chemistry, biology, and engineering to formulate research topics.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Seminar Required

**Also offered as:** CHEE 696C, ENVS 696C, RNR 696C

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.



**MNE 697B: Corporate Organization and Governance in Mining (1 unit)**

**Description:** This course is intended to provide an understanding of organizational practices of public corporations in the mining industry. Students will be led to understand the how relationships with regulators, investors, lenders, employees, communities, governments, and indigenous peoples drive the need for specific and varied talent in the production, technical, management, executive employees as well as the board of directors. Students will learn the importance of organizational structure and culture in the corporate setting.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**Course typically offered:** Online Campus: Fall, Spring

**MNE 697C: Basic Concepts in Mineral Economics (1 unit)**

**Description:** This course provides students with an overview of the field of mineral economics, what it holds in common with other areas of economics and the special requirements of the mineral resources sector.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**MNE 697D: Introduction to Engineering Contract Law (1 unit)**

**Description:** This course will introduce the basics of contract formation, risk allocation and management, applied to a representative cross section of contract types, with the objective of equipping you with the basic tools for functioning effectively in this challenging business environment.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**MNE 697F: Valuation of Mineral Assets and Projects (2 units)**

**Description:** This course provides detailed background and practical application of valuation and risk analysis approaches for determining transaction values for mineral assets.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**Course typically offered:** Online Campus: Fall, Spring

**Recommendations and additional information:** Familiarity with engineering economics or micro and macro economics.

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-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 697G: Acquisition and Financing of Mineral Projects (1 unit)**

**Description:** This course provides detailed background on the negotiation and acquisition strategies used in financing mineral resource development.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**Course typically offered:** Online Campus: Fall, Spring

**Recommendations and additional information:** Familiarity with engineering economics or micro and macro economics. MNE 697F or consent of department.

**MNE 697H: Examination of the Elements of Typical Mining Transactions (1 unit)**

**Description:** This course will examine the elements of typical mining transactions, beginning with an overview of what areas of mineral title and legal issues that need to be examined in performing due diligence for a mineral property. The material will then proceed through the types of agreements encountered in mining transactions. Materials to be considered include check lists and form contracts to control mineral properties, reduce financial risk, protect confidential information and touch on some of the pitfalls of financing.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**Recommendations and additional information:** Recommended MNE 697D or familiarity with basic contract law.

**MNE 697J: Introduction to Stakeholder Engagement (1 unit)**

**Description:** This course gives students hands-on experience in the planning, implementation, analysis, and continuous improvement processes for engaging with project stakeholders. It highlights the various engagement techniques and emphasizes the different approaches to be taken with stakeholders relative to their individual interests in and issues with the project.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

**MNE 697K: Introduction to Social & Environmental Assessment (1 unit)**

**Description:** This course introduces students to the basics of the social and environmental assessment process, gives hands-on experience in the planning and analytical processes, and focuses on the evaluations to be accomplished during each phase of the project cycle.

**Grading basis:** Regular Grades

**Career:** Graduate

**Course Components:** Workshop Required

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**Description:** Project and construction management techniques are widely employed in the minerals industry and other industry sectors. Project management requires knowledge of contract administration, ethics, safety, and how to manage scope, time, cost, quality, resources, and risk. Students will gain practical knowledge to manage large scale industry projects, particularly related to mining.

**Career:** Graduate

**MNE 697O: Politics and Land Use Permitting** (1 unit)

**Description:** The course addresses the increased difficulty in permitting land use developments. It will examine the role that politics plays in controversial proposals, and the difficult nature of mining applications. We will identify the different forms of politics at play in the ongoing NIMBY phenomenon, the typical participants, and the different political agendas at work in this process.

**Career:** Graduate

**Recommendations and additional information:** Graduate students only.

**Description:** Through much of human history, we were not overly concerned about whether natural resource development as good for local populations, or whether they liked it. The fundamental issues in the industry were geological (finding minerals, timber or oil; and gas), or in the case of dam development., finding good hydroelectric sites; engineering (learning the physical processes to produce and obtain the resources efficiently) and processing (finding more useful products and more diverse and creative ways to use resources). The social, cultural and environmental dimensions, and the local economic impact, were in the back seat, and whether local people felt they were receiving benefits was rarely considered an issue. National government officials and developers made the decision, often with little if any input from locals. The principle that can help us understand all these diverse issues is a set of ideas we call "sustainable development." Sustainable development is a set of concepts that attempt to harmonize a number of seemingly competing goals. These include providing better conditions of life and more opportunity for people, especially the poor, They also include bringing production and consumption within limits that ecosystems can tolerate in the long run.

**Career:** Graduate

**Course typically offered:** Online Campus: Fall, Spring

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 699: Independent Study** (1 - 5 units)

**Description:** Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

**MNE 900: Research** (1 - 4 units)

**Description:** Individual research, not related to thesis or dissertation preparation, by graduate students.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

**MNE 909: Master's Report** (3 units)

**Description:** Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

**MNE 910: Thesis** (1 - 6 units)

**Description:** Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department.

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

**MNE 920: Dissertation** (1 - 9 units)

**Description:** Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing).

**Grading basis:** Alternative Grading: S, P, F

**Career:** Graduate

**Course Components:** Independent Study Required

**Repeatable:** Course can be repeated a maximum of 99 times.

**Course typically offered:**

Main Campus: Fall, Spring

Online Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

**May Be Offered** Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.