

MINING ENGINEERING

Emphasis areas at the bachelor level in explosives engineering, mining health and safety, quarry engineering, coal, mining and the environment, and sustainable development.

The mining and explosives engineering programs are offered under the department of mining and nuclear engineering. The overall objectives of the mining engineering program are to provide a broad engineering education with strong expertise in mining engineering, a cultural foundation for the mining industry and a strong basis for future growth and development. These objectives are achieved at the B.S. level by providing education in basic sciences, engineering sciences and design, core mining engineering, humanities and social sciences.

ABET Educational Objectives

The objectives establish broad career and professional attributes that the mining engineering program prepares students to achieve in industry. The educational objectives include:

1. Graduates will become frontline supervisors and middle level managers within three to five years in industry.
2. Graduates will have a vital interest and a passion to remain and promote industry growth.
3. Graduates will be capable of solving industrial problems toward growth and competitiveness of their respective companies.
4. Graduates will become functional and effective leaders or members of industrial teams for carrying out the mission of their respective companies.
5. Graduates will communicate effectively the technical, social and economic aspects of the job requirements to subordinates, peers and superiors.
6. Graduates will carry out their functional responsibilities with supreme understanding of safety and health, environment and ethics.
7. Graduates will cultivate and maintain an interest in life-long learning through professional development and memberships in professional societies.
8. Graduates will continue to grow in the knowledge of relevant technologies, skills and tools for modern mining engineering practice.
4. Become proficient in core mining engineering subjects required to carry out the professional duties of an entry level mining engineer upon graduation (ABET Outcome a).
5. Understand geological and mineral processing dimensions for comprehensive mine design, extraction and mineral beneficiation (ABET Outcome a).
6. Understand geomechanics, geometric and computer-aided mine design, and optimization of flow processes for designing mine layouts to maximize health and safety, economics and production efficiency, and to minimize environmental impacts (ABET Outcome c).
7. Have the ability to outline and conduct experiments, with relevant input data and information, analysis and interpretation to draw inferences for making decisions on maintenance, improvement, or modification of an operating system (ABET Outcome b).
8. Function effectively on a team by understanding team dynamics, communication, social norms and conflict management (ABET Outcome d).
9. Have the ability to identify, formulate and solve closed and open-ended problems in science, engineering, humanities, social sciences, and management from verbal and/or written statements (ABET Outcome e).
10. Understand engineering code of ethics and its impact on professional engineering practice, especially in mine design, mine health and safety, and quality control (ABET Outcome c and f).
11. Develop creative abilities for effective oral and written communication of both technical and non-technical materials for presentations to peers, superiors and subordinates with proficiency (ABET Outcome g).
12. Know contemporary engineering issues through general education requirements, involvement in professional societies, participation in student activities, and reading of professional journals (ABET Outcome j).
13. Develop leadership skills in competitive environments, project teams and organizational units through student chapter organizations, mine rescue, mine design and mucking competitions, student-initiated and student-led field trips, fund raising and community involvement (Program Core Value).
14. Have the desire and motivation toward a life-long learning process via the online Master of Engineering program, preparation toward professional engineering certification, opportunities for conference attendance and research exposure (ABET Outcome i).
15. Acquire the knowledge of the Mining Engineering profession through cooperative and summer internships, field trips and practical working laboratories in the Missouri S&T Experimental Mine (Program Core Value).
16. Acquire the knowledge and familiarity of the complex relationships among technology, government, society, investors, and the environment and their impact on tomorrow's mining industry through guest lectures, in-class presentations, general education subjects and community involvement (ABET Outcome k).
17. Understand global mining issues by participating in exchange programs, internships, and in-class presentations (Program Core Value).

ABET Student Outcomes

Consistent with the definition of ABET student outcomes, the mining engineering program is designed and delivered to allow students opportunities to acquire the following skills, knowledge and behaviors by the time of graduation.

1. Become proficient in the basic sciences, including mathematics, statistics, physics and chemistry and their applications in solving mining engineering problems (ABET Outcome a).
2. Understand fundamental engineering principles in statics and dynamics, mechanics of rock structures, electrical circuits, thermodynamics, fluid mechanics and engineering design and their applications in solving mining engineering problems (ABET Outcome a).
3. Become knowledgeable in the humanities, social sciences and management for understanding the non-technical aspects of the mining engineering profession, including environmental, socio-economic, and the health and safety impacts exemplified by the knowledge of the regulatory regime (ABET Outcome h).

18. Develop a sense of responsibility and appreciation for the continuous well-being of the mining engineering program and Missouri S&T (Program Core Value).

General Program Information

The mining engineering courses provide students with the knowledge necessary to enter a variety of segments of the mining industry. Graduate mining engineers, who satisfactorily complete the program criteria, usually obtain employment in one or more of the following areas: mine engineering, operations management, extraction or processing, base metals, precious metals, industrial minerals, quarry industry, explosives industry, construction or demolition, mining equipment suppliers and mining/geotechnical consulting firms.

The mining engineering profession deals with location, extraction, and use of mineral resources and mineral policy. Lunar and ocean mining constitute new frontiers. The mining engineer is concerned with all phases of mineral recovery, including exploration, evaluation, development, extraction, mine evaluation, reclamation, processing, and marketing of minerals. In addition to engineering, science and liberal arts courses, appropriate courses are taken in explosives engineering, geology, mineral beneficiation, coal mine development and production, mining of metallic and aggregate minerals, mine systems design, mining economics and law, mine hygiene and safety, mine management, mine ventilation, rock mechanics, ground support, and reclamation.

The mining engineer relies upon geologic knowledge and highly sensitive instruments for the location and evaluation of mineral deposits. Problems involved in the development, exploitation and the beneficiation of minerals and marketing of valuable constituents must be determined in advance. Mining must be carried out efficiently, safely, and economically, with the welfare of the public as a primary consideration. Land must be restored to a useful condition after mining ceases and pollution controls must be designed to prevent harmful environmental effects.

Intensive research programs are conducted at Missouri S&T in surface and underground mining, heavy mining machinery, explosives engineering, mine health and safety, oil sands recovery, waterjet excavation, mineral economics, mine operations and design, mine atmospheric control and ventilation, minerals transportation, rock mechanics and applied geophysics. Appropriate research by faculty and graduate students ensures program relevance to industry.

An Experimental Mine and the Rock Mechanics and Explosives Research Center are located close to the campus and provide facilities for laboratory instruction and research. Trips to coal, metal, and industrial mineral operations supplement classroom activities. Summer employment and co-op training provide valuable practical mining and engineering expertise.

Program Mission and Core Values

The Mining Engineering Program at Missouri S&T provides superb education and training to undergraduate and graduate students for the mining and construction industries of Missouri, USA and those global mining companies with strategic interests in the USA. *The programs provide students with total quality education and research capabilities to make a difference in our state and the technological world.*

Core Values

Our vision of global leadership will be achieved through the following seven core values that form the basis of Missouri S&T's tradition of excellence in mining engineering education and research.

Excellence: The efforts of faculty, staff, alumni, industry partners and related organizations create an environment that promotes excellence in education and research.

Ethics: We value truth, honesty, integrity and hard work as abiding principles for professional excellence.

Experience: Through its experimental mine facilities, internships, cooperative education and field trips, students receive hands-on experience, which is vital to the practice of the profession.

Exposure: S&T reaches out to global frontiers through its board of industry executives, alumni, research and professional societies, and our global partners.

Passion: S&T educates graduates with a passion for the mining industry's growth and competitiveness.

Tradition: S&T maintains the tradition of excellence, unity, collegiality and family that have been the bedrock of its mining engineering programs.

Bachelor of Science Mining Engineering

Entering freshmen desiring to study Mining Engineering will be admitted to the Freshman Engineering Program. They will, however, be permitted, if they wish, to state a Mining Engineering preference, which will be used as a consideration for available freshman departmental scholarships. The focus of the Freshman Engineering program is on fundamental sciences and mathematics, enhanced advising and career counseling, with the goal of providing to the student the information necessary to make an informed decision regarding the choice of a major. In addition, students who state the Mining Engineering preference are required to complete Mining Engineering 2126 during the first or second semester on campus.

For the Bachelor of Science degree in Mining Engineering a minimum of 128 credit hours is required, although completion of an emphasis area may require up to 132 credits. These requirements are in addition to credit received for algebra, trigonometry, and basic ROTC courses. A student must maintain at least two grade points per credit hour for all courses taken in the student's major department, and an average of at least two grade points per credit hour must be maintained in Mining Engineering.

Each student's program of study must contain a minimum of 21 credit hours of course work in general education and must be chosen according to the following rules:

1. All students are required to take one American History course, two economics courses, one humanities course, ENGLISH 1120 and either ENGLISH 1160, ENGLISH 3560 or TCH COM 1600. The history course is to be selected from HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200. The economics courses must be either ECON 1100 or ECON 1200, and ECON 3512. The humanities course must be selected from "The Approved List of Humanities and Social Science Courses for Engineering Degrees", maintained by the Office of Undergraduate Studies.
2. The remaining three credit hours must be taken from "The Approved List of Humanities and Social Science Courses for Engineering

Degrees". Foreign language courses can be considered to be one of these courses. (Students may receive humanities credit for foreign language courses in their native tongue only if the course is at the 4000 or 5000 level.)

3. Special topics, special problems courses and honors seminars are allowed only by petition to and approval by the student's department chairman.

The Mining Engineering program at Missouri S&T is characterized by its focus on the scientific basics of engineering and its innovative application; indeed, the underlying theme of this educational program is the application of the scientific basics to engineering practice through attention to problems and needs of the public. The necessary interrelations among the various topics, the engineering disciplines, and the other professions as they naturally come together in the solution of real world problems are emphasized as research, analysis, synthesis, and design are presented and discussed through classroom and laboratory instruction.

Freshman Year

First Semester	Credits	Second Semester	Credits
MATH 1214	4	MATH 1215	4
CHEM 1310	4	PHYSICS 1135	4
CHEM 1319	1	MECH ENG 1720	3
CHEM 1100	1	MIN ENG 1912	2
FR ENG 1100	1	MIN ENG 2126	1
HISTORY 1200, or 1300, or 1310, or POL SCI 1200	3	GEO ENG 1150	3
ENGLISH 1120	3		
	17		17

Sophomore Year

First Semester	Credits	Second Semester	Credits
MATH 2222	4	MATH 3304	3
MIN ENG 2925	2	MIN ENG 2412	3
MIN ENG 3912	3	MECH ENG 2527	3
MIN ENG 3913	3	MECH ENG 2350	2
CIV ENG 2200	3	PHYSICS 2135	4
ECON 1100 or 1200	3		
	18		15

Junior Year

First Semester	Credits	Second Semester	Credits
STAT 3113 or 3115	3	MIN ENG 4522	3
NUC ENG 3221 or CIV ENG 3330	3	MIN ENG 4512	3
MIN ENG 4932	3	MIN ENG 4933	3
CIV ENG 2210	3	MIN ENG 4823	3
ECON 3512	3	ENGLISH 1600, or 1160, or 3560	3
GEOLOGY 3310	3		
	18		15

Senior Year

First Semester	Credits	Second Semester	Credits
MIN ENG 5612	3	MIN ENG 4742	3
MIN ENG 4912	3	MIN ENG 4097	4
MIN ENG 4096	3	Technical Elective ^{1,2,3,4,5,6}	3
MIN ENG 4113	3	H/SS Elective	3

H/SS Elective	3	
	15	13

Total Credits: 128

- 1 **Explosives Engineering Emphasis:** MIN ENG 5622 (Blasting Tech) and either MIN ENG 4001 (Special Topics Explosives), MIN ENG 4099 (Undergraduate Research in Explosives), MIN ENG 4823 (Rock Mechanics) or MIN ENG 4922 (Tunneling/Construction) have to be taken as Technical Electives.
- 2 **Quarrying Emphasis:** Two of CIV ENG 3116 (Construction Materials); MIN ENG 4212 (Advanced Aggregate and Quarrying); and MIN ENG 4412 (Aggregate Materials) have to be taken as Technical Electives.
- 3 **Coal Emphasis:** Two of MIN ENG 4322 (Coal Mine Development and Production), MIN ENG 4414 (Mine Plant Management) or an approved substitute course must be taken as Technical Electives.
- 4 **Mining and the Environment Emphasis: GEO ENG 5235** (Environmental Geological Engineering) and GEO ENG 5233 (Risk Assessment in Environmental Studies), or approved substitute courses have to be taken as Technical Electives.
- 5 **Mining Health and Safety Emphasis:** MIN ENG 3002 (Mine Rescue), ENG MGT 4330 (Human Factors), or other approved substitute courses must be taken as Technical Electives.
- 6 **Sustainable Development Emphasis: POL SCI 3310** (Public Policy Analysis), ECON 4440 (Environmental and Natural Resource Economics), or other approved substitute courses must be taken as Technical Electives.

Graduating Mining Engineers Examination

Mining engineering students must complete the Fundamentals of Engineering Examination prior to graduation as a senior assessment requirement. A passing grade is not required to earn a B.S. degree in mining engineering; however it is the first step toward becoming a registered professional engineer. This requirement is part of the Missouri S&T assessment process. Students must sign a release form giving the University access to their Fundamentals of Engineering Examination score.

Mining Health and Safety Emphasis

Junior and Senior Years

MIN ENG 3002	Mine Rescue (or approved substitute course in lieu of Technical Elective.)	3
ENG MGT 4330	Human Factors (or approved substitute course in lieu of Technical Elective.)	3

Sustainable Development Emphasis

Junior and Senior Years

POL SCI 3300	Principles Of Public Policy (or approved substitute course in lieu of Technical Elective.)	3
ECON 4440	Environmental And Natural Resource Economics (or approved substitute course in lieu of Technical Elective.)	3

Quarrying Engineering Emphasis

Senior Year

CIV ENG 3116	Construction Materials, Properties And Testing (in lieu of Technical Elective.)	3
MIN ENG 4212	Advanced Aggregate and Quarrying (in lieu of Technical Elective.)	3

Explosives Engineering Emphasis

Junior and Senior Years

Choose one of the following courses in lieu of Technical Elective in Junior Year:

A three-credit hour explosives engineering (EXP ENG) course

MIN ENG 4922 Tunneling & Underground Construction Techniques
or MIN ENG 5922 Advanced Tunneling & Underground Construction Techniques

GEO ENG 5471 Rock Engineering

In lieu of Technical Elective in Senior Year:

EXP ENG 5622 Blasting Design And Technology

Coal Emphasis

Junior and Senior Years

MIN ENG 4322	Coal Mine Development And Production (in lieu of Technical Elective.)	3
MIN ENG 4414	Mine Plant Management (or approved substitute course in lieu of Technical Elective.)	2

Mining and the Environment Emphasis

Junior and Senior Years

ENV ENG 5640	Environmental Law And Regulations	3
GEO ENG 5233	Risk Assessment In Environmental Studies (or approved substitute course in lieu of Technical Elective.)	3

Minor in Mining Engineering

A student who receives a Bachelor of Science degree in an accredited engineering program from Missouri S&T may receive the Minor in Mining Engineering by completing 15 credit hours from the courses listed below. Non-engineering students who have a strong background in mathematics and the physical sciences may also qualify for the Minor in Mining Engineering or Explosives Engineering with the approval of the Department and based on an individually designed program of study. Students will need to consult with the Chair of the Mining Engineering Program to determine pre-requisite requirements for each course. The program granting the Bachelor of Science degree shall determine whether or not courses taken for the Mining Engineering Minor or Explosives Engineering Minor may also be used to fulfill the requirements of the B.S. degree from that program.

The following courses are required for the Minor in Mining Engineering:

MIN ENG 3913	Mineral Identification and Exploration	3
MIN ENG 4932	Underground Mining Methods And Equipment	3
MIN ENG 4933	Surface Mining Methods And Equipment	3

Two other Mi Eng 3000-, 4000-, or 5000-level lecture courses (3 credit hours), or relevant courses from other disciplines, as approved, must be taken to match the student's area of emphasis in Mining Engineering. The following areas of emphasis may be pursued:

Explosives Engineering; Quarrying; Mineral Economics; Mining-Environmental; Mining-Equipment; Mining-Geo-technical; Mining-Health and Safety; Mining Operations Management; Mining-Tunneling; Sustainable Development; Surface Mining; Underground Mining.

The Minor in Mining Engineering is not accredited by the Accreditation Board of Engineering and Technology (ABET).

Minor in Mineral Processing

The minor in Mineral Processing provides an in-depth study of the fundamental theories and applications of mineral and coal processing and aggregate materials sizing and classification. Any student who

receives a Bachelor of Science degree in an accredited engineering program from Missouri S&T may also receive the minor in Mineral Processing by completing 15 credit hours in this specialty. The B.S. degree granting program shall determine whether or not courses taken for the minor in Mineral Processing may also be used to fulfill the requirements of the B.S. degree from that program.

The following courses are required for the minor in Mineral Processing:

MIN ENG 3412		3
MIN ENG 4422	Coal Preparation	3
MIN ENG 4412	Aggregate Materials Characterization, Sizing and Dimension Stone	3
MIN ENG 4423	Mineral Processing I (Flotation and Hydrometallurgy)	3
MIN ENG 4424	Mineral Processing II (Mechanics and Design)	3

Minor in Explosives Engineering

The department of mining and nuclear engineering, mining engineering program, realizing the attractiveness of explosives engineering to students, the potential for jobs in the area (post 9-11), and the use of over 6 billion pounds of explosives in mining, tunneling, construction, and other areas, is offering a minor in explosives engineering so that students interested in explosives engineering have a chance to attain in-depth knowledge of the sub-discipline.

A student who received a bachelor of science degree in an accredited engineering program from Missouri S&T may receive the minor in explosives engineering by completing 15 credit hours from the courses listed below. Non-engineering students who have a strong background in mathematics and the physical sciences may also qualify for the minor in explosives engineering, with the approval of the department and based on an individually designed program of study. Students need to consult with the chair of the explosives engineering program to determine pre-requisite requirements for each course. The program granting the bachelor of science degree shall determine whether or not courses taken for the explosives engineering minor may also be used to fulfill the requirements of the B.S. degree from that program.

The following courses are required for the minor in explosives engineering:

EXP ENG 5612/ MIN ENG 5612	Principles of Explosives Engineering	3
EXP ENG 5622/ MIN ENG 5622	Blasting Design And Technology	3

Three other explosives related courses as approved by program coordinator.

The minor in explosives engineering is not accredited by the Accreditation Board of Engineering and Technology (ABET).

Undergraduate Certificate in Explosives Engineering

This certificate program is designed to provide formalized education in the area of explosives engineering.

Students will be exposed to the theoretical and practical approaches of explosives engineering. Students will be exposed to the analysis and design of explosive-related systems and both natural and built structure effects.

The explosives engineering certificate program is open to all persons holding a high school diploma who have a minimum of 12-months of post-high school, professional employment or college experience.

Once admitted to the program, the student must take four designated courses as given below. In order to receive an undergraduate certificate, the student must have an average cumulative grade of 2.0 or better in the certificate courses.

Students admitted to the certificate program will have non-matriculated status; however, if they complete the four course sequence with a grade of B or better in each of the courses taken, they may apply to the B.S. mining engineering program if they so choose. The certificate credits taken by students admitted to the B.S. program may be eligible to count toward their bachelors degrees depending on the degree requirements. Prerequisite courses outside of those in this certificate program may be waived at the discretion of the administrative co-coordinators for persons that are not regular Missouri S&T students.

Once admitted to the program, a student will be given three years to complete the program so long as he/she maintains a 2.0 GPA in the courses taken.

Required courses:

MIN ENG 5612	Principles of Explosives Engineering	3
MIN ENG 5622	Blasting Design And Technology	3
Select two of the following:		
MIN ENG 4001	Special Topics	
MIN ENG 309		
MIN ENG 4922	Tunneling & Underground Construction Techniques	
MIN ENG 4099	Undergraduate Research (Explosives Engineering related)	
MIN ENG 4000	Special Problems (1. Explosives Engineering related. 2. At discretion of coordinators)	

Other courses approved by the explosives engineering faculty may be substituted for any of the above listed courses on a case-by-case basis.

Students with a GPA of 3.0 in the certificate program may take postgraduate explosives classes as electives.

Lana Z Alagha, Assistant Professor
PHD University of Texas at Dallas
Mineral processing, tailings management, polymer science, nanotechnology, interfacial science, colloidal interactions in aqueous systems, and clays.

Nassib S Aouad, Assistant Professor
PHD Missouri Science and Technology
Mechanical design and automation, machine health and fatigue analysis, machinery and whole-body vibrations, advanced vibrations modeling and analysis, numerical modeling and simulation, virtual prototyping, and computational fluid dynamics.

Kwame Awuah-Offei, Associate Professor
PHD University of Missouri-Rolla
Life cycle sustainability assessment, community acceptance modeling, energy efficiency modeling, production optimization, CO2 hazard delineation and innovative post-mining land uses for underground mines.

Samuel Frimpong, Professor¹
PHD University of Alberta, Canada
Surface mining, formation excavation, heavy machinery imaging and integration, intelligent mining systems, stochastic processes and risks simulation, extra heavy oil extraction, and mine safety, and health and hazards engineering.

Grzegorz Galecki, Associate Professor
PHD Wroclaw Tech University, Poland
System integration, modeling of mining processes supported by waterjets, novel methods of comminution, particulate processing, coal conversion into fuels, borehole mining, and mineral processing.

Maochen Ge, Associate Professor
PHD Penn State University
Rock mechanics and ground control, underground mine design, acoustic emissions, micro-seismic phenomena in underground mines, theory and applications of geotomology, non-destructive structural testing, and numerical methods.

Catherine Johnson, Assistant Professor
PHD University of Kentucky

Braden Lusk, Professor¹
PHD University of Missouri-Rolla

Kyle Perry, Assistant Professor¹
PHD University of Kentucky

Paul Nicholas Worsley, Professor¹
PHD University of Newcastle-upon-Tyne, United Kingdom
Explosives engineering, drilling and blasting, rock excavation, demolition, and commercial pyrotechnics.

MIN ENG 1912 Principles Of Mining Engineering (LEC 2.0)
Principles and definitions related to mining engineering including one or more field trips to familiarize the student with current mining practices.

MIN ENG 1913 Computing In Mining Engineering (LAB 1.0)
Basic software needed by mining engineers for computer applications in various phases of mine planning, development, and operations will be covered. The overarching goal is developing early familiarity with relevant software so it can be integrated across mining engineering courses.

MIN ENG 2126 Introduction To Mining Safety (LAB 1.0)
Safety aspects of mining in accordance with the MSHA Training Program required for all new miners. Subjects include self-rescue and respiratory protection, ground control, hazard recognition, mine gases, and legal aspects associated with mining.

MIN ENG 2412 Principles Of Mineral Processing (LAB 1.0 and LEC 2.0)
Introduction to the principles of mineral processing including mineral resources; particle comminution, classification, separation and dewatering; flowsheet and equipment design.

MIN ENG 2914 Surface Mine Design (LAB 2.0 and LEC 1.0)
Surface mining methods. Conventional methods for ore reserves estimation. Geomechanics, geometrics and computer-aided mine design, haul roads and waste dump design and layouts optimization. Materials scheduling and sequencing using a commercially available mine design software. Prerequisite: Min Eng 1912.

MIN ENG 2924 Underground Mine Design (LAB 2.0 and LEC 1.0)
Underground mining methods. Parametric statistics and introductory geostatistics. Geomechanics, geometrics and computer-aided mine design. Empirical and numerical methods for mine openings, pillar and roof span design; caving and ore drawing mechanics. Materials scheduling and sequencing using commercially available software. Prerequisite: Min Eng 1912 and Min Eng 2914.

MIN ENG 2925 Surveying For Mineral Engineers (LAB 2.0)

Principles of surface and underground survey practice utilizing total station, engineer's level and GPS. Traversing and details, note taking and computations, balancing surveys and error analysis, staking-out new points, and map construction with AutoCAD. Prerequisite: Preceded or accompanied by Min Eng 1912.

MIN ENG 3000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MIN ENG 3001 Special Topics (IND 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MIN ENG 3002 Mine Rescue (LAB 1.0 and LEC 2.0)

Utilization of the principles of mine safety concerning mine gases, ventilation, explosives, fires, and first aid in the organization of mine rescue personnel and techniques. Training in the use of current mine rescue equipment, recognition and control of common recovery hazards, handling of survivors. Prerequisite: Min Eng 2126.

MIN ENG 3512 Mining Industry Economics (LEC 3.0)

Importance of the mineral industry to national economy, uses, distribution, and trade of economic minerals, time value of money, mineral taxation, economic evaluation utilizing depreciation, depletion, and discounted cashflow concepts, social and economical significance of mineral resources. Prerequisite: Econ 1100 or 1200. (Co-listed with Econ 3512).

MIN ENG 3812 Statics And Mechanics Of Rock Materials (LEC 2.0 and LAB 1.0)

Application of the principles of mechanics to engineering problems of equilibrium, strength, and stiffness concerning rock materials and mine support structures. This course extends the study of statics to rock materials in mines and covers rock-related and support structure-related mechanics of materials. The course is complemented by rock mechanics laboratory. Prerequisites: MECH ENG 2340; or IDE 50 and 150.

MIN ENG 3912 Materials Handling In Mines (LAB 1.0 and LEC 2.0)

Mining applications of material transport and handling. Truck haulage and haulroads. Conveyors: belt, armored, and others; feeders; bins and bunkers; material stockpiling and homogenization; rail transport; water transport; slurry transport; mine hoists and hoisting. Prerequisite: Min Eng 1912.

MIN ENG 3913 Mineral Identification and Exploration (LEC 3.0)

Characterization of mineral deposits. Ore body definition. Mineral Exploration techniques. Sample methods, errors and mitigation. Rock Identification. Prerequisites: Either both Chem 1310 and Chem 1319 or Chem 1351; either Geo Eng 1150 or Geology 1110.

MIN ENG 4000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MIN ENG 4001 Special Topics (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MIN ENG 4096 Computer Aided Mine Design (LAB 3.0)

Mine planning and design using commercial software. Orebody description. Surface mining: geometric design, pit limits, and production planning. Underground mining: development planning, opening and support design, ventilation and production planning. Group projects with real-world mining data. Preparation for capstone design project. Prerequisites: Min Eng 4522, Min Eng 4932, and Min Eng 4933.

MIN ENG 4097 Capstone Design Project (LEC 1.0 and LAB 3.0)

Capstone project with written and oral presentations. Includes mine design and optimization, production plan, equipment and flowsheet design based on geology, resources/reserves, geotechnics, hydrology and hydro-geology. Project also incorporates markets, environmental and permitting, mine-mill organization, support facilities, economic and risk analyses. Prerequisite: Min Eng 4096.

MIN ENG 4099 Undergraduate Research (IND 0.0-6.0)

Designed for the undergraduate student who wishes to engage in research. Not for graduate credit. Not more than six credit hours allowed for graduation credit. Subject and credit to be arranged with the instructor.

MIN ENG 4113 Mine Atmosphere Control (LEC 2.0 and LAB 1.0)

Fundamentals of mine ventilation, including the principles of airflow, control of gases, dust, and temperature, methane drainage, mine fans, network theory, computer network simulation, and economics of airflow, with emphasis on analysis, systems design and practical application. Prerequisites: Chem 3410 and Civ Eng 3330.

MIN ENG 4122 Advanced Mine Health and Safety (LEC 3.0)

A detailed study of health and safety principles, practices, analyses, regulations, issues and technology in the mining industry. Prerequisite: Min Eng 2126.

MIN ENG 4212 Advanced Aggregate and Quarrying (LEC 3.0)

Advanced coverage of topics on the stone and aggregate industry, including surface and underground operations, plant equipment, economics, marketing, transportation, and environmental topics. The course will include at least one field trip and a design project. Prerequisite: Min Eng 3912, co-requisite: Civ Eng 3116.

MIN ENG 4322 Coal Mine Development And Production (LEC 3.0)

An in-depth study of all aspects of coal mining, including an overview of coal industry, reserves and geology, planning and development of coal mines, surface and underground mechanized methods of face preparation, equipment, coal extraction, handling and preparation as practiced in the United States. Prerequisite: Accompanied or preceded by Min Eng 4912.

MIN ENG 4412 Aggregate Materials Sizing and Characterization (LAB 1.0 and LEC 2.0)

Geological formation of aggregates; aggregate properties and their measurements; aggregates for specific end-user applications; specifications and standards; processing (crushing, screening, classification, and washing); plant design and flow sheet analysis; quality control and assurance. Prerequisite: Min Eng 3412.

MIN ENG 4413 Material Processing By High-Pressure Water Jet (LEC 3.0)

Methods of generating high pressure water jets; standard equipment, existing techniques and basic calculations. Applications of water jets to materials cutting and mineral processing. Safety rules. The course will be supported by laboratory demonstrations. (Co-listed with Mech Eng 5606).

MIN ENG 4414 Mine Plant Management (LEC 2.0)

Optimization of mine plant and equipment performance. Availability, utilization and reliability of equipment; matching equipment and plant to minesite specific conditions; maintenance planning, scheduling and control; parts and materials supply systems; mine information and management systems. Basics of mine automation and robotics. Prerequisite: Senior standing or consent of instructor.

MIN ENG 4422 Coal Preparation (LEC 2.0 and LAB 1.0)

Coal properties, sampling, testing, breaking, sizing, cleaning and dewatering. Disposal of refuse. Prerequisites: Min Eng 3412 and senior standing.

MIN ENG 4423 Mineral Processing I (Flotation and Hydrometallurgy) (LAB 1.0 and LEC 2.0)

Forth flotation including mineral surfaces, double layer theory, zeta potential, hydrophobicity, adsorption, collectors, frothers, modulation, kinetics, and sulphide and acid flotation systems. Hydrometallurgy including leaching, ion exchange and liquid/liquid extraction. Prerequisite: Min Eng 3412.

MIN ENG 4424 Mineral Processing II (Mechanics and Design) (LEC 2.0 and LAB 1.0)

Mineral particle mechanics of comminution, sizing, classification, concentration, filtering and thickening. Mill and equipment selection and design including flowsheet, development and plant assessment. Prerequisite: Min Eng 3412. (Co-listed with Met Eng 5270).

MIN ENG 4512 Mine Management (LEC 3.0)

Theory and practice of mine management, including basic managerial functions, management theories, communication skills, motivation, leadership, organization, maintenance management, managerial decision making, cost control, labor relations, government relations, ethics and risks management with emphasis in presentation skills. Prerequisite: Completion of 50 credits toward Mining Engineering degree. (Co-listed ECON 4512).

MIN ENG 4522 Ore Reserve Analysis And Geostatistics (LAB 1.0 and LEC 2.0)

An introduction to principles of geostatistics, theory of spatially correlated random variables, variance and co-variances and their application on the evaluation of mineral resources, ore reserve estimation, strategic exploration, and production planning. Real case studies from mining industry will be presented. Prerequisite: Stat 3113 or Stat 3115.

MIN ENG 4523 Environmental And Natural Resource Economics (LEC 3.0)

Optimum use of replenishable and non-replenishable resources, public goods and common resources, externalities, private vs. public costs, and quality of the environment; emphasis on public policy related to environmental and natural resource economics. Prerequisite: Econ 2100. (Co-listed with Econ 4440).

MIN ENG 4524 Energy Economics (LEC 3.0)

Market structure. World resource development. Supply and demand analysis on energy production and consumption within domestic and global settings. Prerequisite: Econ 2100. (Co-listed with Econ 4540).

MIN ENG 4742 Environmental Aspects Of Mining (LEC 3.0)

Permitting: the legal environment of reclamation and environmental impact assessment; post-mining land-use selection and mine planning for optimum reclamation of all mines: metal, nonmetal, and coal; unit operations of reclamation: drainage, backfill, soil replacement, revegetation, maintenance, etc. Prerequisites: Co-requisites: MIN ENG 4933 or GEO ENG 5441 or ENV ENG 5619. (Co-listed with GEO ENG 4276).

MIN ENG 4823 Rock Mechanics (LAB 1.0 and LEC 2.0)

Applications of the fundamental principles of mechanics to engineering problems of equilibrium, strength and stiffness of rock materials. Review of in-situ stresses, laboratory and field instrumentation, rock and rockmass properties, pillar design, roof span design, rock reinforcement, surface subsidence, slope stability, and violent failures. Field trip required. Prerequisites: Physics 2135; Civ Eng 2210; Geology 3310.

MIN ENG 4824 Soils and Overburden Materials for Mining Engineering (LEC 2.0)

Physical and mechanical properties of soils and overburden materials. Soils and overburden characterization for reclamation and mine closure and overburden blasting. Soil failure modes and slope stability for surface mine layouts, waste dumps, tailings and earth dams, and foundations for heavy mining machinery. Prerequisites: Civ Eng 2210.

MIN ENG 4912 Mine Power And Drainage (LEC 2.0 and LAB 1.0)

Engineering principles of mine power distribution and application and mine dewatering. Basics of electrical circuits, AC/DC power, transformers, electric meters, power distribution, power management. Hydraulic power systems. Compressed air in mines. Mine dewatering. Controlling water inflow. Dewatering wells. Water pumping and pumping systems. Prerequisites: Chem 3410 and Civ Eng 3330.

MIN ENG 4922 Tunneling & Underground Construction Techniques (LAB 1.0 and LEC 2.0)

Cover both mechanical excavation and conventional excavation techniques to underground tunneling and construction. The emphasis will be on equipment selection and prediction of performance expected of the equipment. Ground control systems will be covered as technology emerges. Excavation methods and support of large caverns, often found in civil structures, will also be discussed. A limited focus will be on underground construction specifications and underground advance rate and cost estimation techniques. Prerequisites: Min Eng 4823, Min Eng 4932 or Civ Eng 3715, Civ Eng 3116 or Geo Eng 5471.

MIN ENG 4932 Underground Mining Methods And Equipment (LEC 3.0)

Principles of planning, constructing, and operating economically viable underground mines. Cost effective mining methods: room-and-pillar, sublevel open stoping, VCR, shrinkage, sublevel caving, cut-and-fill, block caving, longwall. Selection of equipment for underground mining operations. Optimization of mine performance. Field Trip Required. Prerequisite: Preceded or accompanied by Min Eng 3913.

MIN ENG 4933 Surface Mining Methods And Equipment (LEC 3.0)

Principles of planning, constructing, and operating economically viable surface mines. Cost effective mining methods: placer mining, strip mining, open pit mining, quarrying. Selection of equipment for surface mining operations. Optimization of mine performance. Field trip required. Prerequisites: Min Eng 3912; Min Eng 3512; preceded or accompanied by Min Eng 4823.

MIN ENG 5000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of the instructor required.

MIN ENG 5001 Special Topics (IND 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

MIN ENG 5113 Advanced Mine Atmosphere Control (LEC 2.0 and LAB 1.0)

Advanced mine ventilation network based on airflow requirements, control of gases, dust, and temperature, methane drainage, mine fans, network theory based on the Code of Federal Regulations. Computer simulation of ventilation systems, mine fire simulation, and economics of airflow based on underground mine layouts. Research paper or design project required. Prerequisite: Mi Eng 4113 or Consent of Instructor.

MIN ENG 5122 Advanced Topics in Mine Health and Safety (LEC 3.0)

Advanced topics in mine health and safety including practices and regulations; risks and hazards recognition, mitigation and control; disaster prevention and control. Students will complete a research paper or project report. Pre-requisite: Mi Eng 4122 or Consent of Instructor.

MIN ENG 5212 Advanced Aggregates and Quarrying (LEC 3.0)

Advanced topics in aggregates mining, mine design and planning, and project valuation. In-pit crushing and conveying, and advances in comminution technology for the aggregates industry. Design project or research paper required. Prerequisite: Mi Eng 4212 or Consent of Instructor.

MIN ENG 5322 Advanced Coal Mining Methods (LEC 3.0)

Advanced topics in coal mining methods, planning and development of surface and underground mining systems; planning of logistics, resources, infrastructure for large-scale surface coal mines; face preparation, equipment interface, haulage systems, sequencing and scheduling and extraction from underground coal mines. Students will complete a research paper or project report. Prerequisites: Min Eng 4322 or Consent of Instructor.

MIN ENG 5412 Advanced Aggregates Sizing and Characterization (LEC 2.0 and LAB 1.0)

Advanced methods for evaluating aggregate occurrences, extraction, material flow sheet analysis; Advances in processing and classification; advanced statistical methods for quality control and assurance, and standards. Students will complete and present a research paper on the subject. Field trip to a nearby quarry required. Prerequisite: Mi Eng 4412 or Consent of Instructor.

MIN ENG 5413 Adv Mtl Proc Hghpres Wtr Jet (LEC 3.0)

Advanced methods for continuously generating high pressure, power calculations, applications of waterjets in the mining and manufacturing industries, and safety considerations. Research paper or design project required. Prerequisite: Mi Eng 4413 or Consent of Instructor.

MIN ENG 5422 Advanced Coal Preparation (LEC 2.0 and LAB 1.0)

Advanced methods for designing coal processing circuitry and practices, flowsheet design, sampling, advanced ash and moisture analyzers; coarse, intermediate, and fine coal cleaning; dewatering; dry coal cleaning research. Research paper or design project required. Prerequisite: Mi Eng 4422 or Consent of Instructor.

MIN ENG 5423 Advanced Flotation and Hydrometallurgy (LEC 2.0 and LAB 1.0)

Theoretical basis of froth flotation, electrical characteristics at interfaces, interfacial forces, adsorption kinetics and thermodynamics, flotation reagents, flotation process flowsheets. Physicochemical principles of hydrometallurgical processes, leaching methods and reagents. Hydrometallurgical processes flowsheets. Research paper or design project required. Prerequisites: Mi Eng 4423 or Consent of Instructor.

MIN ENG 5424 Advanced Mechanics And Design (LAB 1.0 and LEC 2.0)

Strategy of beneficiation as a combination of unit operations: Mineral sampling and particle size distribution, mineral particle mechanics of comminution and energy requirement, mineral crushing and grinding circuits, classification, solid-liquid separation and instrumentation, Mineral processing plant flow sheet design. Research paper or design project required. Prerequisites: Mi Eng 4424 or Consent of Instructor.

MIN ENG 5522 Advanced Ore Reserve Analysis And Geostatistics (LEC 2.0 and LAB 1.0)

Advanced discussions on principles of geostatistics, theory of spatially correlated random variables, variance and co-variances and their application on the evaluation of mineral resources, ore reserve estimation, strategic exploration, and production planning. Real case studies from mining industry will be presented. Course project. Prerequisites: Math 3304 & Stat 3113 or instructor consent.

MIN ENG 5532 Advanced Mining Economics (LEC 3.0)

Mining industry & national economics. Social & economics significance of mined commodities. Marketing of mined commodities. Innovation approaches to mine financing, project loans, and leasing. Mining feasibility studies, government influence & policy, mining industry foreign investment, investment strategies, mining taxation, cost predictions. Case Studies.

MIN ENG 5612 Principles of Explosives Engineering (LEC 2.0 and LAB 1.0)

Theory and application of explosives in the mining industry; explosives, initiating systems, characteristics of explosive reactions and rock breakage, fundamentals of blast design, drilling and blasting, regulatory and safety considerations. Prerequisites: Min Eng 2126; successful background check. (Co-listed with Exp Eng 5612).

MIN ENG 5622 Blasting Design And Technology (LEC 2.0 and LAB 1.0)

Advanced theory and application of explosives in excavation; detailed underground blast design; specialized blasting including blast casting, construction and pre-splitting. Introduction to blasting research. Examination of field applications. Prerequisites: Min Eng 5612. Student must be at least 21 years of age. Successful background check. (Co-listed with Exp Eng 5622).

MIN ENG 5742 Advanced Environmental Aspects of Mining (LEC 3.0)

Applied and fundamental research issues pertaining to: permitting -- the legal environment of reclamation and environmental impact assessment; post-mining land-use selection and mine planning for optimum reclamation of all mines: metal, nonmetal, and coal; unit operations of reclamation: drainage, backfill, soil replacement, revegetation, maintenance, etc. Course project. Prerequisites: Min Eng 5932 and 5933 or instructor consent. (Co-listed with GE XXXX).

MIN ENG 5822 Strata Control (LEC 3.0)

A detailed review of artificial ground support, both above and below ground, including slope stabilization techniques and shaft and tunnel liner design. The use of shotcrete, roofbolts, and solid liners and the principles of underground longwall and room and pillar mine support. Longwall and hydraulic mining practice is covered. Prerequisite: Min Eng 4823.

MIN ENG 5823 Rock Mechanics III (LAB 1.0 and LEC 2.0)

Advanced methods for designing rock excavation to resolve geotechnical and ground control problems. Topics including stress analysis, rock properties, instrumentation, pillar design, roof span design, rock reinforcement, surface subsidence, rock burst, and slope stability. Research paper or design project required. Prerequisites: Mi Eng 4823 or Consent of Instructor.

MIN ENG 5912 Advanced Mine Power And Drainage (LEC 2.0 and LAB 1.0)

Advanced methods for evaluating electric power requirements and distribution mining geometries; Design and evaluation of mine drainage systems based on power requirements, layouts efficiency, hydraulic gradients, water-bearing formations; Risk evaluation of emergency power failures and mine flooding. Research paper or project required. Prerequisite: Mi Eng 4912 or Consent of Instructor.

MIN ENG 5913 Advanced Computer Aided Mine Design (LEC 2.0 and LAB 1.0)

Project-based mine planning and design course. Engineering design process applied to computer-aided mine planning and design. Mine layouts, production planning, and materials scheduling optimization. Prerequisite: Graduate standing.

MIN ENG 5922 Advanced Tunneling & Underground Construction Techniques (LEC 2.0 and LAB 1.0)

Advanced topics in mechanical and conventional excavation techniques in underground tunneling and construction. Topics include tunneling layouts design, equipment and performance modeling, ground control systems including support, drainage, and structural integrity. Construction specifications, advance rate and contractual and cost estimation. Prerequisite: Consent of instructor. (Co-listed with Exp Eng 5922).

MIN ENG 5932 Advanced Underground Mining Methods (LEC 3.0)

Advanced methods for designing, planning, developing and operating economic and efficient underground mining systems. Systems include mass mining methods, room and pillar, longwall, cut and fill with equipment, ventilation and drainage control interface. Research paper or design project required. Prerequisite: Mi Eng 4932 or Consent of Instructor.

MIN ENG 5933 Advanced Surface Mining Methods (LEC 3.0)

Advanced topics in surface mine planning, methods and equipment acquisition, and deployment in surface mining operations. Strategic and tactical mine planning with focus on efficiency, safety, environmental standards and economics. It will also focus on fleet management with emphasis on repair, rebuild and replacement for higher availabilities, utilization and production output. Students will complete a research paper or project report. Prerequisites: Min Eng 4933 or Consent of Instructor.