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 & explosives engineering. Mining engineering graduates are employed in mine engineering, mine operations management, mineral processing, construction or demolition, application engineering for mining and construction equipment, and mining or geotechnical consulting.

The B.S. degree in mining engineering provides you with the knowledge necessary to enter a variety of career paths in the mining and construction sectors. Mining engineering graduates work for base and precious metals, industrial minerals and aggregates operations; construction companies; and for service and technology providers including equipment manufacturers, consulting companies and explosives suppliers to the mining industry.

You will develop a strong foundation in basic mathematics, physics, chemistry, and engineering sciences in your first few semesters. In the final stage of your B.S. degree, you will learn to use those basics to solve mining engineering problems such as mine design, mine equipment selection, ventilation, geomechanics and ground control, blasting and ground fragmentation, and evaluating the feasibility of mineral projects. To offer some degree of specialization, students can choose from one of our emphasis areas.

ABET Educational Objectives
The objectives establish broad career and professional attributes that the mining engineering program prepares students to achieve in industry. The mining engineering program seeks to prepare its graduate for the following early career and professional accomplishments:

1. Demonstrated engineering competence, successfully contributing within their career fields with increasing levels of responsibility and influence.
2. Continuous growth in knowledge and capability, within the Mining Engineering field as well as across interdisciplinary boundaries.

ABET Student Outcomes
The mining engineering program has the same student outcomes as the campus student outcomes. Thus, graduates of the mining engineering program will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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 mine engineering, mine operations management, mineral processing, construction or demolition, application engineering for mining and construction equipment, and mining or geotechnical consulting. These engineers work for base and precious metals mines, industrial minerals and aggregates operations; construction companies; and for service and technology providers including equipment manufacturers, consulting companies and explosives suppliers to the mining industry.

The mining engineering profession deals with discovery, extraction, and use of mineral resources as well as mineral policy. Space and ocean mining constitute new frontiers. The mining engineer is concerned with all phases of mineral discovery and exploitation, including exploration, evaluation, development, extraction, processing, marketing, reclamation, and processing minerals. In addition to engineering, science and liberal arts courses, students take relevant courses in explosives engineering, geology, mineral beneficiation, mine systems design, mineral economics, mine health and safety, mine management, mine ventilation, rock mechanics, and sustainability.

Missouri S&T has active research in sustainable minerals and resources, health and safety, energetic materials, ground control, and automation. Missouri S&T faculty and research assistants (both graduate and undergraduate students) work closely with industry partners to ensure their research is relevant to industry.

An Experimental Mine and the Energetics Research Facility are located close to the campus and provide facilities for laboratory instruction and research. Trips to nearby 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 quality education and research capabilities to make a difference in our state and the world.

Bachelor of Science
Mining Engineering
The Mining Engineering program at Missouri S&T is characterized by its focus on the scientific basics of engineering and its innovative
application to the extraction of (critical) minerals to meet societal needs. Indeed, the underlying theme of this educational program is the application of basic science to engineering practice by solving engineering problems related to mineral extraction. These problems include the safe and sustainable extraction of minerals to power green energy. 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.

Incoming students who state the Mining Engineering preference are required to complete MIN ENG 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 meet requirements as specified under "Engineering Degree Requirements" published in the current undergraduate catalog.

2. The remaining three credit hours must meet requirements as specified under "Engineering Degree Requirements" published in the current undergraduate catalog. 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.

### Freshman Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 1214 or 1211</td>
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<td>MATH 1215</td>
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<td>CHEM 1310</td>
<td>4</td>
<td>PHYSICS 1135</td>
<td>4</td>
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<tr>
<td>CHEM 1319</td>
<td>1</td>
<td>MECH ENG 1720</td>
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<td>CHEM 1100</td>
<td>1</td>
<td>MIN ENG 1912</td>
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<td>MIN ENG 2126</td>
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<td>GEO ENG 1150</td>
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<tr>
<td>FR ENG 1100</td>
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<tr>
<td>HISTORY 1200, or 1300, or 1310, or POL SCI 1200</td>
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<tr>
<td>ENGLISH 1120</td>
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### Sophomore Year

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<td>MATH 3304</td>
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<td>MATH 2222</td>
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<td>MECH ENG 2527</td>
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<td>MECH ENG 2350</td>
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<td>CIV ENG 2200</td>
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<td>PHYSICS 2135</td>
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<td>ECON 1100 or 1200</td>
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### Junior Year

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<td>STAT 3113 or 3115</td>
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<td>MIN ENG 4512</td>
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<td>NUC ENG 3221 or CIV ENG 3330</td>
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<td>MIN ENG 5522</td>
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<td>MIN ENG 5932</td>
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<td>MIN ENG 5823</td>
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<td>CIV ENG 2210</td>
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<td>MIN ENG 5933</td>
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<td>ECON 3512</td>
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<td>ENGLISH 1600, or 1160, or 3560</td>
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<td>GEOLOGY 3310</td>
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### Senior Year

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<tr>
<td>MIN ENG 5612</td>
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<td>MIN ENG 5742</td>
<td>3</td>
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<tr>
<td>MIN ENG 5912</td>
<td>3</td>
<td>MIN ENG 4097</td>
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<td>MIN ENG 4096</td>
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<td>Technical Elective</td>
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<td>H/SS Elective</td>
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<td>H/SS Elective</td>
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<tr>
<td>MIN ENG 5113</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td><strong>Total Credits:</strong></td>
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<td></td>
<td>13</td>
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</table>

**Total Credits: 128**

1. **Explosives Engineering Emphasis:** MIN ENG 5622 (Blasting Tech) and MIN ENG 5823 (Rock Mechanics) or MIN ENG 5922 (Tunneling/Construction) have to be taken as Technical Electives.

2. **Quarrying Emphasis:** Two of CIV ENG 3116 (Construction Materials), MIN ENG 5212 (Aggregate and Quarrying), and MIN ENG 5412 (Aggregate Materials) have to be taken as Technical Electives.

3. **Coal Emphasis:** Two of MIN ENG 5322 (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
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 5212 Aggregates and Quarrying 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
- EXP ENG 5922 Tunneling & Underground Construction Techniques 3
- GEO ENG 5471 Rock Engineering

In lieu of Technical Elective in Senior Year:
- EXP ENG 5622 Blasting Design And Technology 3

Coal Emphasis
Junior and Senior Years

MIN ENG 5322 Coal Mining Methods 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 5932 Underground Mining Methods 3
- MIN ENG 5933 Surface Mining Methods 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 2412 Principles Of Mineral Processing 3
- MIN ENG 5412 Aggregates Materials Sizing and Characterization 3
- MIN ENG 5422 Coal Preparation 3
- MIN ENG 5423 Flotation and Hydrometallurgy 3
- MIN ENG 5424 Mineral Processing II Mechanics And Design 3

Minor in Explosives Engineering

The department of mining & explosives 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:

...
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, a student will be given three years to complete the program so long as he/she maintains a 2.0 GPA 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 bachelor's 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 who 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EXP ENG 5612</td>
<td>Principles of Explosives Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 5612</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP ENG 5622</td>
<td>Blasting Design And Technology</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 5622</td>
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</tbody>
</table>

Choose any two courses from the list below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP ENG 5555</td>
<td>Computer Fired Pyrotechnic Show Design and Firing System Operation</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5112</td>
<td>Explosives Handling and Safety</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5512</td>
<td>Commercial Pyrotechnics Operations</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5513</td>
<td>Stage Pyrotechnics and Special Effects</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5514</td>
<td>Display Fireworks Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5713</td>
<td>Demolition of Buildings and Structures</td>
<td>3</td>
</tr>
<tr>
<td>EXP ENG 5922</td>
<td>Tunneling &amp; Underground Construction Techniques</td>
<td>3</td>
</tr>
<tr>
<td>or MIN ENG 5922</td>
<td>Tunneling &amp; Underground Construction Techniques</td>
<td>3</td>
</tr>
<tr>
<td>or MIN ENG 492</td>
<td>Tunneling &amp; Underground Construction Techniques</td>
<td>3</td>
</tr>
</tbody>
</table>

Any 4000 level explosives course or other explosive-related course with approval of the student's advisor and instructor permission.

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

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

Kwame Awuah-Ofeii, Professor, Union Pacific/Rock Mountain Energy Professor of Mining Engineering, and Department Chair1 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, Professor, Robert H. Quenon Chair in Mining Engineering1 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 Emeritus 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.

Catherine Johnson, Robert H. Quenon Associate Professor of Mining Engineering, Associate Professor of Explosives Engineering PHD University of Kentucky
Environmental Considerations of blasting, fragmentation prediction, biological effects of shock exposure, explosibility of dusts.

Kyle Perry, Associate Professor and Associate Chair for Academic Affairs1 PHD University of Kentucky
Explosion protection, mine blasting effects, dust explosions, ground control.

Taghi Sherizadeh, Assistant Professor PHD University of Arizona
Computational mechanics; numerical, statistical, and probabilistic modeling in rock mechanics; rock slope stability and stability of underground excavations; application of numerical modeling in underground and surface mining; reservoir geomechanics (Wellbore stability, Hydraulic fracturing, and Sand production); geomechanical aspects of CO2 sequestration; geothermal Energy recovery; assessment of nuclear waste disposal sites; pore pressure and in-situ stress analysis; compaction and subsidence modeling, artificial Intelligence (artificial neural networks, fuzzy logic and genetic algorithms).

Paul Nicholas Worsey, Professor Emeritus1 PHD University of Newcastle-upon-Tyne, United Kingdom
Explosives engineering, drilling and blasting, rock excavation, demolition, and commercial pyrotechnics.
Guang Xu, Associate Professor
PHD Virginia Tech
Mine ventilation, health and safety; mining-induced particulate matter (PM) monitor and control, underground fire safety, computational fluid dynamics (CFD), enhanced coalbed methane recovery using microwave technology.

**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 2002 Cooperative Engineer Training** (IND 0.0-6.0)
On-the-job experience gained through cooperative education with industry, with credit arranged through departmental cooperative advisor. Grade received depends on quality of reports submitted and work supervisor’s evaluation.

**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)

**MIN ENG 2924 Underground Mine Design** (LAB 2.0 and LEC 1.0)

**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 2126.

**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 3913 Mineral Identification and Exploration** (LAB 1.0 and LEC 2.0)

**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 5522, Min Eng 5932, and Min Eng 5933.
MIN ENG 407 Capstone Design Project (LAB 3.0 and LEC 1.0)  
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 4122 Advanced Mine Health and Safety (LEC 3.0)  
A detailed study of health and safety principles, practices, analyses, regulations, risks and hazards recognition, mitigation and control, and disaster prevention in the mining industry. Prerequisite: Min Eng 2126.

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 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 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 1100. (Co-listed with Econ 4440).

MIN ENG 4524 Energy Economics (LEC 3.0)  
For students interested in both economic and engineering issues of energy policy. Provides an assessment of economics and technology issues related to traditional and renewable energy resources. Presented in a framework that allows for analysis of the economic trade-offs between energy sources and the technologies associated with their use and extraction. Prerequisite: Econ 1100 or Econ 1200. (Co-listed with Econ 4540).

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. Prerequisite: Civ Eng 2210.

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 4932, Min Eng 3715, Civ Eng 3116 or Geo Eng 5471.

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 (LEC 0.0-6.0)  
This course is designed to give the department an opportunity to test a new course. Variable title.

MIN ENG 5113 Mine Atmosphere Control (LAB 1.0 and LEC 2.0)  
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. Prerequisite: Mech Eng 2527 and Civ Eng 3330; or Nuc Eng 3221.

MIN ENG 5212 Aggregates 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; Preceded or accompanied by Civ Eng 3116.

MIN ENG 5232 Coal Mining Methods (LEC 3.0)  
An in-depth study of all aspects of coal mining, including an overview of the 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. Prerequisites: Min Eng 5912.

MIN ENG 5322 Aggregates 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. Field trip to a nearby quarry required. Prerequisite: Min Eng 2412.
MIN ENG 5413 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 5422 Coal Preparation (LAB 1.0 and LEC 2.0)
Coal properties, sampling, testing, breaking, sizing, cleaning and 
dewatering. Disposal of refuse. Prerequisite: Min Eng 2412.

MIN ENG 5423 Flotation and Hydrometallurgy (LAB 1.0 and LEC 2.0)
Froth flotation including mineral surfaces, double layer theory, zeta 
potential, hydrophobicity, adsorption, collectors, frothers, modulation, 
kinetcs, and sulphide and acid flotation systems. Hydrometallurgy 
including leaching, ion exchange and liquid/liquid extraction. 
Prerequisites: Min Eng 2412.

MIN ENG 5424 Mineral Processing II Mechanics And Design (LAB 1.0 and 
LEC 2.0)
Mineral particle mechanics of comminution, sizing, classification, 
concentration, filtering and thickening. Mill and equipment selection 
and design including flowsheet, development and plant assessment. 
Prerequisites: Min Eng 2412. (Co-listed with Met Eng 5270).

MIN ENG 5522 Ore Reserve Analysis and Geostatistics (LAB 1.0 and LEC 
2.0)
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. Prerequisites: Math 3304; Stat 3113 or Stat 
3115.

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 (LAB 1.0 and LEC 2.0)
Theory and application of explosives in the mining industry; explosives, 
initiating systems, characteristics of explosive reactions and rock 
brakeage, 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 (LAB 1.0 and LEC 2.0)
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 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: Preceded or accompanied 
by Min Eng 5933 or Geo Eng 5441 or Env Eng 5619. (Co-listed with Geo 
Eng 5276).

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 
5823.

MIN ENG 5823 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. Ground Control; pillar design, roof span design, 
rock reinforcement, surface subsidence, slope stability, and violent 
failure. Prerequisites:Physics 2135; Civ Eng 2210; Geology 3310. Field trip 
required.

MIN ENG 5912 Mine Power and Drainage (LAB 1.0 and LEC 2.0)
Engineering principles of mine power distribution and application and 
mine dewatering. Basics of electrical circuits, AC/DC power, transformers, 
electric meters, power distribution, and power management. Hydraulic 
power systems. Compressed air in mines. Mine dewatering. Controlling 
water inflow. Dewatering wells. Water pumping and pumping systems. 
Prerequisite: Mech Eng 2527 and Civ Eng 3330; or Nuc Eng 3221.

MIN ENG 5913 Advanced Computer Aided Mine Design (LAB 1.0 and LEC 
2.0)
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 Tunneling & Underground Construction Techniques (LAB 1.0 
and LEC 2.0)
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 Underground Mining Methods (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 
Prerequisite: Preceded or accompanied by Min Eng 3913.
MIN ENG 5933 Surface Mining Methods (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 5823.