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 PEOs 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.

ABET Student Outcomes

Consistent with the definition of ABET SOs, 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).
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).
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: mining 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, mining 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 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.

For the Bachelor of Science degree in Mining Engineering a minimum of 128 credit hours is required. 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 18 credit hours of course work from the humanities and the social sciences areas and should be chosen according to the following rules:

1. All students are required to take one American history course and one economics course. The history course is to be selected from HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200. The economics course may be either ECON 1100 or ECON 1200.

2. Of the remaining hours, six credit hours must be taken in humanities or social sciences at the 2000 level or above and must be selected from the approved lists. Each of these courses must have as a prerequisite one of the humanities or social sciences courses already taken. 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. Some departments list specific requirements; e.g., a psychology course, a literature course, and/or a second semester of economics. Selections should be made to ensure that these requirements are met.

4. 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.

<table>
<thead>
<tr>
<th>Freshman Year</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHEM 1310</td>
<td>4</td>
<td>MATH 1215</td>
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<tr>
<td>CHEM 1319</td>
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<td>PHYSICS 1135</td>
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<td>CHEM 1100</td>
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<td>MECH ENG 1720</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1214</td>
<td>4</td>
<td>MIN ENG 1912(^8)</td>
<td>1</td>
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<tr>
<td>FR ENG 1100</td>
<td>1</td>
<td>MIN ENG 2126</td>
<td>1</td>
</tr>
<tr>
<td>GEO ENG 1150</td>
<td>3</td>
<td>GEOLOGY 2611</td>
<td>3</td>
</tr>
<tr>
<td>HISTORY 1200, or 1300, or 1310, or POL SCI 1200</td>
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<td>17</td>
<td>16</td>
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<thead>
<tr>
<th>Sophomore Year</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MIN ENG 2925</td>
<td>2</td>
<td>ENGLISH 1120</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 3912</td>
<td>3</td>
<td>PHYSICS 2135</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2222</td>
<td>4</td>
<td>MECH ENG 2340(^1)</td>
<td>3</td>
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<tr>
<td>GEOLOGY 3310</td>
<td>4</td>
<td>MATH 3304</td>
<td>3</td>
</tr>
<tr>
<td>ECON 1100 or 1200</td>
<td>3</td>
<td>MIN ENG 2924</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 2914</td>
<td>3</td>
<td>19</td>
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<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN ENG 3913</td>
<td>3</td>
<td>MIN ENG 4932</td>
<td>3</td>
</tr>
<tr>
<td>ENGLISH 1600</td>
<td>3</td>
<td>MIN ENG 4933</td>
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<tr>
<td>CIV ENG 3330</td>
<td>3</td>
<td>MIN ENG 3412</td>
<td>3</td>
</tr>
<tr>
<td>STAT 3113</td>
<td>3</td>
<td>MIN ENG 4823</td>
<td>3</td>
</tr>
<tr>
<td>Human/Soc Sc(^1)</td>
<td>3</td>
<td>MIN ENG 4113</td>
<td>3</td>
</tr>
<tr>
<td>Human/Soc Sc(^1)</td>
<td>3</td>
<td>15</td>
<td>18</td>
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<table>
<thead>
<tr>
<th>Senior Year</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN ENG 4912</td>
<td>3</td>
<td>MIN ENG 4742</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4512(^8)</td>
<td>2</td>
<td>MIN ENG 4099(^8)</td>
<td>4</td>
</tr>
<tr>
<td>MIN ENG 5612</td>
<td>3</td>
<td>Human/Soc Sc(^1)</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4824</td>
<td>2</td>
<td>Technical Elective(^2,3,4,5,6,7)</td>
<td>3</td>
</tr>
</tbody>
</table>

**MIN ENG 4096** 1
**Technical Elective\(^2,3,4,5,6,7\)** 3

**Total Credits: 128**

1. The curriculum contains a total of 21 general education credit hours. The three HSS electives must be from the approved list with at least one course (3 or more hours) that builds on depth and at least one course (3 or more hours) that focuses on the economics of a large enterprise, such as the mining industry, e.g. ECON 4440 or ECON 3512. The latter also satisfies the depth requirement.

2. Explosives Engineering Emphasis: MIN ENG 5622 and either MIN ENG 4001, MIN ENG 4099 (both in an explosives area), GEO ENG 5471 or MIN ENG 4922 must be taken as Technical Electives.

3. Quarrying Emphasis: CIV ENG 3116 and MIN ENG 4212 must be taken as Technical Electives.

4. Coal Emphasis: MIN ENG 4322, MIN ENG 4414 or an approved substitute course must be taken as Technical Electives.

5. Mining and the Environment Emphasis: ENV ENG 5640, GEO ENG 5233, or approved substitute courses must be taken as Technical Electives.

6. Mining Health and Safety Emphasis: MIN ENG 3002, ENG MGT 4330, or other approved substitute courses must be taken as Technical Electives.

7. Sustainable Development Emphasis: POL SCI 3300, ECON 4440, or other approved substitute courses must be taken as Technical Electives.

8. Mining courses offered every semester.

**Graduating Mining Engineers Examination**

Mining engineering students must complete the Graduating Mining Engineers (GME) Examination prior to graduation as a senior assessment requirement. A passing grade on this examination is required to earn a B.S. degree in mining engineering. The GME Exam is comprised of the Surface Mining Engineering (SME) and Underground Mining Engineering (UME) Examinations. The SME Exam focuses on MIN ENG 3912 Materials Handling In Mines, MIN ENG 2914 Surface Mine Design, MIN ENG 3412 Principles Of Mineral Processing, MIN ENG 5612 Principles Of Explosives Engineering, MIN ENG 4933 Surface Mining Methods And Equipment, and MIN ENG 4824 Soils and Overburden Materials for Mining Engineering. The UME Exam focuses on MIN ENG 2924 Underground Mine Design, MIN ENG 3512 Mining Industry Economics, MIN ENG 4912 Mine Power And Drainage, MIN ENG 4932 Underground Mining Methods And Equipment, and MIN ENG 4823 Rock Mechanics.

Mining engineering students are required to pass the GME Exam in order to graduate. The GME Exam will be graded with Pass or Fail designation. A mark below 50% will be assigned a failing grade and a mark of 85% or above will be a Pass with Distinction. Graduating seniors will have two opportunities to complete the GME requirement. However, students who fail these two attempts can register and complete the examination after completing the required 128 credits in Mining Engineering.

**Mining Health and Safety Emphasis**

Junior and Senior Years

MIN ENG 3002 Mine Rescue (or approved substitute course in lieu of Technical Elective.)
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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN ENG 3913</td>
<td>Mining Exploration</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4932</td>
<td>Underground Mining Methods And Equipment</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4933</td>
<td>Surface Mining Methods And Equipment</td>
<td>3</td>
</tr>
</tbody>
</table>

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 Engineering
- Sustainable Development
- Coal Emphasis
- Advanced Aggregate and Quarrying
- Construction Materials, Properties And Testing
- Principles Of Public Policy

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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN ENG 3412</td>
<td>Principles Of Mineral Processing</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4422</td>
<td>Coal Preparation</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4412</td>
<td>Aggregate Materials Sizing And Characterization</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4423</td>
<td>Mineral Processing I (Flotation and Hydrometallurgy)</td>
<td>3</td>
</tr>
<tr>
<td>MIN ENG 4424</td>
<td>Mineral Processing II (Mechanics and Design)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Minor in Explosives Engineering**

The Department of Mining & 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 Mining Engineering or Explosives Engineering with the approval of the Department and based on an individually designed program of study.
based on an individually designed program of study. Students 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 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/MIN** Principles Of Explosives Engineering 3
- **EXP ENG/MIN** 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-H.S. 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:

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

Select two of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN ENG 4001</td>
<td>Special Topics</td>
<td></td>
</tr>
<tr>
<td>MIN ENG 309</td>
<td></td>
<td></td>
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</tbody>
</table>

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.

**Bayram Suha Aksoy**, Assistant Teaching Professor

PHD Virginia Polytechnic and State University

Minerals/coal processing, surface chemistry, zeta potential, flotation, industrial minerals beneficiation, comminution agglomeration of minerals, fine particles separation.

**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.

**Jason Baird**, Associate Professor

PHD University of Missouri-Rolla

Blast and ballistic-resistant structures, advanced blasting and demolition, energetic materials, explosives safety and risk assessment and risk management, advanced polymeric and composite materials, explosive taggants, explosives-driven pulsed power, and plasma effects on explosion shocks for pulsed power.

**Richard L Bullock**, Professor Emeritus

DE University of Missouri-Rolla

Underground mining methods, tunneling and construction, and mine feasibility studies.

**Samuel Frimpong**, Professor

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.

Gregory Gelles, Professor
PHD West Virginia University
Finance, risks and uncertainty, and mathematical analysis.

Argyle Douglas Stewart Gilles, Professor
PHD University of New South Wales, Australia
Underground mining methods, mine ventilation and atmospheric control, mine power and drainage, mining industry economics, coal mining, and mine safety and health.

Tad S Golosinski, Professor Emeritus
PHD University of Mining and Metallurgy, Poland
Surface mining methods and equipment, mine plant management, belt conveying, hoist and hoist system.

R Larry Grayson, Professor Emeritus
PHD West Virginia University
Advanced mine safety and health, materials accounting, mine optimization, modeling, coal mining, and energy systems.

Zeshan Hyder, Assistant Teaching Professor
PHD Virginia Polytechnic and State University
Underground coal gasification, sustainable development, GIS modeling and software, environmental impacts, rock mechanics, passive tomography, acoustic emissions, geomechanical and fracture modeling, LCA modeling, rock blasting and fragmentation control.

Stephen Anthony Lang, Lecturer
ME University of Missouri-Rolla
Mine management, global mining, sustainable development, and financial literacy - OSC regulations.

Ahmed S Sayed-Ahmed, Assistant Teaching Professor
PHD University of Kentucky
Mineral/coal processing, applied surface chemistry, fine particle and advanced physical separation, phosphate beneficiation, plant design and flotation, dense media separation, triboelectrostatic separation, process optimization and stimulation.

Cheryl M Seeger, Lecturer
PHD University of Missouri-Rolla
Economic geology, mineralogy and petrology, and exploration geology.

David A Summers, Curators Professor Emeritus
PHD University of Leeds, United Kingdom
Water-jet science and engineering, rock excavation, strata control, biofuels engineering, hydraulic mining, and precision drilling.

Syed M Tariq, Teaching Professor
PHD University of Missouri-Rolla
Associate Chair for the SMP Program. Controlled blasting, surface hardrock mining, blast vibration monitoring and control, slope engineering.

Jerry C Tien, Associate Professor
PHD University of Missouri-Rolla
Underground mining methods, mine ventilation and atmospheric control, mine power and drainage, mining industry economics, coal mining, mine safety and health.

Paul Nicholas Worsey, Professor
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 1.0)
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)
Instruction in the safety aspects of mining 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. Prerequisite: Accompanied or preceded by Min Eng 1912.

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: Math 1160, accompanied or preceded 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 3412 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 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** (LAB 1.0 and LEC 2.0)
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 haul roads. 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 Mining Exploration** (LEC 3.0)

**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 Mine Design Project I** (LAB 1.0)
Formation of mine design project teams and acquisition of project data from industry. Geostatistical methods for ore reserves estimation. Develop complete project schedule and milestones for executing the project tasks in Min Eng 4097 (Mine Design Project II). Set up database for Min Eng 4097 and interact with selected mine design software packages. Prerequisites: Min Eng 2914 and Min Eng 2924.

**MIN ENG 4097 Mine Design Project II** (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. Prerequisites: Min Eng 4932, Min Eng 4933, Min Eng 4096 and completion of 110 hours in the Mining Engineering Curriculum.

**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** (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: 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-required: Civ Eng 3116.

**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 mine-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** (LAB 1.0 and LEC 2.0)
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)** (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. Prerequisite: Min Eng 3412. (Co-listed with Met Eng 5270).
**MIN ENG 4512 Mine Management** (LEC 2.0)
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, with emphasis in presentation skills. Prerequisite: Completion of 100 credits in Mining Engineering curriculum.

**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. Prerequisites: Math 3304, Stat 3113.

**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: Geo Eng 1150; Min Eng 4932 and 4933 or prereq./coreq. Civ Eng 3715. (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: IDE 2340, or Civ Eng 2200 and IDE 2350; and 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: IDE 2340, or Civ Eng 2200 and IDE 2350.

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

**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)

**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 2914; Min Eng 3512; coreq. 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** (LAB 1.0 and LEC 2.0)
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 (LAB 1.0 and LEC 2.0)
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 Mit 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 (LAB 1.0 and LEC 2.0)
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 (LAB 1.0 and LEC 2.0)
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 (LAB 1.0 and LEC 2.0)
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 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 breakage, fundamentals of blast design, drilling and blasting, regulatory and safety considerations. Prerequisites: Min Eng 2126; accompanied or preceded by Civ Eng 2715 or Geology 3310 or Geology 2611; Successful background check. (Co-listed with Exp Eng 5612).
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.