MINING ENGINEERING

The mining engineering program in the department of mining & explosives engineering offers the graduate certificate, master of engineering (M.E.), master of science (M.S.), doctor of philosophy (Ph.D.) and doctor of engineering (D.E.) degrees in mining engineering. The M.S. with thesis and Ph.D.degrees require research components for program completion. The core research strengths include surface mining methods and heavy mining machinery, mine ventilation and mine atmospheric control, explosives engineering, sustainable development and mine optimization, rock mechanics and ground control, minerals, coal and materials processing, minerals and energy economics, and underground mining methods and equipment. Graduate students in any of these programs must consult the graduate degree requirements in mining engineering, the graduate catalog of Missouri S&T and their respective advisors.

The graduate certificate program requires 12 credit hours in core courses. Students must have a minimum cumulative GPA of 3.00/4.00 to receive the graduate certificate in mining engineering. The ME program requires a minimum of 30 credit hours, offered via distance (online). The required credit hours include 15 core credit hours, 12 credit hours in technical electives and 3 credit hours for a semester project. The mining engineering program offers an M.S. degree with thesis. The M.S. degree with thesis option requires a minimum of 30 credit hours, including the required research for the thesis. The program requirements must include a minimum of 6 credit hours of 6000-level lecture courses, 6 credit hours of courses outside the major field, and 6 credit hours for thesis research. M.S. candidates must pass a final oral examination of the thesis to complete the program. The M.S. degree by coursework option requires a minimum of 30 credit hours, including a minimum of 9 credit hours of 6000-level lecture courses and 3 credit hours for a semester project. The Ph.D. program requires a minimum of 3 years of full-time study beyond the bachelor's degree, including research work for the dissertation. Ph.D. candidates must complete at least 15 credit hours of course work at Missouri S&T and are required to pass the qualifying, comprehensive and final oral examinations of the Ph.D. program. The D.E. degree requires a minimum of 3 years of full-time study beyond the bachelor's degree, including research work for the dissertation. D.E. students must pass the qualifying, comprehensive and final oral examinations and must also satisfy an engineering internship requirement.

Major Research Areas

The eight research major areas include (i) surface mining methods and heavy mining machinery; (ii) mine ventilation and mine atmospheric control; (iii) explosives engineering; (iv) sustainable development and mine optimization; (v) rock mechanics and ground control; (vi) mineral, coal and materials processing; (vii) minerals and energy economics; and (viii) underground mining methods and equipment. **Surface mining methods and heavy mining machinery research** focuses on surface mining, formation excavation, heavy machinery imaging and integration, mine safety and health, machine and component health, equipment vision, intelligent mining systems and stochastic processes and risks simulation. Specific research frontiers include (i) mining methods, design and production systems; (ii) formation failure dynamics, machine-formation interactions; (iii) kinematics, dynamics and virtual prototype simulation; (iv) machine health and longevity; (v) augmented equipment vision; (vi) machine vibrations and operator health; (vii) tire durability management; (viii) intelligent excavation; (ix) machine automation; (x) random fields and stochastic processes; (xi) numerical, parametric and stochastic simulation.

Mine ventilation and mine atmospheric control research focuses on mine ventilation network modeling and planning, diesel particulate matter (DPM), mine dust control, mine fire simulation and firefighting. Specific research frontiers include (i) ventilation network simulation, (ii) DPM discharge dissipation modeling and control strategies, (iii) spontaneous combustion modeling, firefighting and emergency planning; and (iv) computational fluid dynamics modeling of particulate matter. **Explosives engineering research** focuses on improvements in commercial explosives and blasting agents, mining-related uses of explosives, explosives safety, blast-resistant structures, b arriers to blast, fragments, and ballistic penetration, and explosive-driven pulsed power. Specific research frontiers include (i) design, evaluation, analysis, and test; (ii) barrier concepts, standoff distance analysis, barrier design and test; (iii) design, evaluation, analysis, and test of explosive-driven pulsed power generator concepts and power conditioning systems.

Sustainable development and mine optimization research focuses on r eserve estimation and ore control, production scheduling and optimization, and critical materials sustainability assessment and modeling. Specific research frontiers include (i) geostatistics, ore (dig) outline optimization; (ii) mixed integer LP formulations, computational efficiency, discrete event simulation, optimization, energy efficiency modeling; (iii) mining applications of life cycle assessment, life cycle sustainability assessment, social acceptance modeling, global critical material supply chain sustainability modeling, reclaimed mine land stray-gas hazards. **Rock Mechanics and ground control** research focuses on ground control, acoustic emission/microseismic, geophysical methods in mines, and non-destructive testing. Specific research frontiers include (i) pillar design, mine support, rockburst, slope stability; (ii) monitoring design, location methods, error analysis; (iii) geotomography, in-seam seismic method, void detection; and (iv) integrity of structures and monitoring of aging infrastructure.

Minerals, coal and materials processing research focuses on mineral processing, tailings management, polymer science, nanotechnology, interfacial science, colloidal interactions in aqueous systems, clays, coal-based fuels, ultrafine and submicron grinding, slurry rheology, carbon separation and synthetic fuels. **Minerals and energy economics research** focuses on supply and use of minerals and energy in society, minerals and energy markets and electricity markets, minerals and energy and economic growth, economics of minerals and energy infrastructure, minerals and energy policy, minerals and energy derivatives, minerals and energy demand forecast, elasticity of supply and demand in minerals and energy markets, climate change and climate policy, and sustainable minerals and energy development. **Underground mining methods and equipment research** focuses on mass mining, machine design and automation, underground mine support, machine vibration, novel mining methods, numerical modeling, virtual prototype simulation and computational fluid dynamics.

Major Research Facilities

Mining, minerals and explosives engineering research initiatives are carried out in world-class environments at Missouri S&T. Major research facilities include the following:

- Energetics Research Facility (http://catalog.mst.edu/graduate/researchcentersandinstitutes/energeticsresearchfacility/)
- Experimental Mine (http://catalog.mst.edu/graduate/specialfacilitiesandprograms/experimentalmine/#text)
- Mineral Processing Laboratory (http://catalog.mst.edu/graduate/specialfacilitiesandprograms/mineralprocessinglaboratory/)
- Rock Mechanics and Explosives Research Center (http://catalog.mst.edu/graduate/researchcentersandinstitutes/rockmechanicsandexplosivesresearchcenterrmerc/#text)
- Rock Mechanics Laboratory (http://catalog.mst.edu/graduate/specialfacilitiesandprograms/rocksmechanicslaboratory/)
- Virtual Surface Mining Simulator (http://catalog.mst.edu/graduate/specialfacilitiesandprograms/virtualsurfaceminingsimulator/)
- High Pressure Waterjet Laboratory (http://catalog.mst.edu/graduate/specialfacilitiesandprograms/highpressurewaterjetlaboratory/#text)

Aggregates Management Certificate

PROGRAM DESCRIPTION

The Aggregates Management Certificate Program is designed to provide formalized education in management for the aggregates and industrial minerals mining sector. This certificate program aims to equip students with skills that allow them to be effective plant/mine managers for this sector.

Students admitted to this certificate program must take the four required courses provided in the curriculum section, and obtain a cumulative GPA of 3.0 or better to earn the certificate. Students are admitted in non-matriculated status; however, if they complete the graduate certificate with a grade of "B" or better in each of the courses taken, they may be admitted to the Master of Science degree
program in mining engineering, if they choose to. The certificate credits taken by students admitted to this program will count toward their master's degree.

ADMISSION:

The Aggregates Management Certificate Program is open to all persons holding a B.S., M.S., or Ph.D. degree in Engineering, science, and/or Mathematics or are currently accepted into a graduate degree program at Missouri S&T.

Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Aggregates Management Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in mining engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Aggregates Management Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

CONTRIBUTING FACULTY:

Mining Engineering; Explosives Engineering

REQUIRED COURSES

MIN ENG 5212	Aggregates and Quarrying	3
MIN ENG 5412	Aggregates Materials Sizing and Characterization	3
MIN ENG 5612	Principles of Explosives Engineering	3
MIN ENG 6532	Mine Management II	3

Mining Project Evaluation Certificate

PROGRAM DESCRIPTION:

The Mining Project Evaluation Certificate Program is designed to provide formalized education in mining project evaluation. The program aims to equip students with skills that allow them to evaluate mining projects in order to facilitate investment decisions.

Students admitted to this program must take the four required courses provided in the curriculum section, and obtain a cumulative GPA of 3.0 or better to earn the certificate. Students are admitted in non-matriculated status; however, if they complete the graduate certificate with a grade of "B" or better in each of the courses taken, they may be admitted to the Master of Science degree program in mining engineering, if they so choose. The certificate credits taken by students admitted to the graduate degree program will count toward their master's degree.

ADMISSION:

The Mining Project Evaluation Certificate Program is open to all persons holding a B.S., M.S., or Ph.D. degree in Engineering, Science, and/or Mathematics or are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Mining Project Evaluation Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in mining engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Mining Project Evaluation Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

CONTRIBUTING FACULTY:

Mining Engineering

CURRICULUM:

The graduate certificate in mining project evaluation requires 12 credit hours (four courses) and must include at least three of the following courses:

MIN ENG 5522	Ore Reserve Analysis and Geostatistics	3
MIN ENG 5532	Advanced Mining Economics	3
MIN ENG 5913	Advanced Computer Aided Mine Design	3
MIN ENG 6522	Mining Property Feasibility Studies And Evaluation Procedure	3

Students can select one from the following courses:

MIN ENG 5212	Aggregates and Quarrying	3
MIN ENG 6912	Advanced Simulation of Mining Systems	3
MIN ENG 6932	Advanced Mining Systems	3
MIN ENG 6936	Surface Mine Design	3

Mine Reclamation Certificate

PROGRAM DESCRIPTION:

The Mine Reclamation Certificate Program is designed to provide formalized education in mine reclamation. The program aims to equip students with skills that allow them to work as mine reclamation professionals and regulators on mine reclamation projects. The program is designed for engineers, geologists, and other scientists who find themselves working in mine reclamation without formal training.

Students admitted to this certificate program must take the four required courses provided in the curriculum section, and obtain a cumulative GPA of 3.0 or better to earn the certificate. Students are admitted in non-matriculated status; however, if they complete the graduate certificate with a grade of "B" or better in each of the courses taken, they may be admitted to the Master of Science degree program in mining engineering, if they choose to. The certificate credits taken by students admitted to the graduate degree program will count toward their master's degree.

ADMISSION:

The Mine Reclamation Certificate Program is open to all persons holding a B.S., M.S., or Ph.D. degree in Engineering, Science, and/or Mathematics or are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Mine Reclamation Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in mining engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Mine Reclamation Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

CONTRIBUTING FACULTY:

Mining Engineering; Environmental Engineering; Geological Engineering

CURRICULUM:

The graduate certificate in mine reclamation requires 12 credit hours (four courses) and must include at least two of the following courses:

MIN ENG 5742	Environmental Aspects of Mining	
ENV ENG 5635	Phytoremediation and Natural Treatment Systems: Science and Design	
GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	
Students can select up to two more courses from the following courses:		
ENV ENG 5630	Remediation of Contaminated Groundwater And Soil	
ENV ENG 5640	Environmental Law And Regulations	
ENV ENG 5642	Sustainability, Population, Energy, Water, and Materials	
GEO ENG 5235	Environmental Geological Engineering	
GEO ENG 5331	Subsurface Hydrology	
or GEO ENG 5332	Fundamentals of Groundwater Hydrology	
MIN ENG 6712	Managing Social and Environmental Risks in Mining (Intro to Responsible Mining)	
MIN ENG 6735	Sustainability In Mining	

Sustainability in Mining Certificate

PROGRAM DESCRIPTION:

The Sustainability in Mining Certificate Program is designed to provide formalized education in sustainability in mining. The program aims to equip students with skills that allow them work as professionals and regulators who deal with mine sustainability issues including sustainability assessment and reporting, stakeholder/community engagement, and similar matters. The program is designed for engineers, geologists, and other scientists who find themselves working in mine reclamation without formal training.

Students admitted to this certificate program must take the four required courses provided in the curriculum section, and obtain a cumulative GPA of 3.0 or better to earn the certificate. Students are admitted in non-matriculated status; however, if they complete the graduate certificate with a grade of "B" or better in each of the courses taken, they may be admitted to the Master of Science degree program in mining engineering, if they so choose. The certificate credits taken by students admitted to the graduate degree program will count toward their master's degree.

ADMISSION:

The Sustainability in Mining Certificate Program is open to all persons holding a B.S., M.S., or Ph.D. degree in Engineering, Science, and/or Mathematics or are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Sustainability in Mining Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in mining engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Sustainability in Mining Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

CONTRIBUTING FACULTY:

Mining Engineering; Environmental Engineering

CURRICULUM:

The graduate certificate in sustainability in mining requires the following courses:

MIN ENG 5742	Environmental Aspects of Mining	3
MIN ENG 6712	Managing Social and Environmental Risks in Mining (Intro to Responsible Mining)	3
MIN ENG 6735	Sustainability In Mining	3
ENV ENG 5642	Sustainability, Population, Energy, Water, and Materials	3

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 clays.

Kwame Awuah-Offei, Professor, Union Pacific/Rock Mountain Energy Professor of Mining Engineering, and Department Chair[1]
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 Engineering[1]
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, 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, 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 Affairs[1]
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); geomechnical aspects of C02 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 Emeritus[1]
PHD University of Newcastle-upon-Tyne, United Kingdom
Explosives engineering, drilling and blasting, rock excavation, demolition, 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 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 5322 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 5412 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)
Forth flotation including mineral surfaces, double layer theory, zeta potential, hydrophbicity, adsorption, collectors, frothers, modulation, kinetics, 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 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 (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 operations. Optimization of mine performance. Field trip Required. 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.

MIN ENG 6000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MIN ENG 6001 Special Topics (LAB 1.0 and LEC 2.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

MIN ENG 6010 Seminar (RSD 1.0)
Discussion of current topics.

MIN ENG 6040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/ comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

MIN ENG 6050 Continuous Registration (IND 1.0)
Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

MIN ENG 6080 Graduate Project (IND 3.0)
Advanced engineering design, experimentation, evaluation and assessment leading to the preparation of a project report. For practicing professionals, this project could be based on an actual industry problem. Prerequisites: Graduate Standing.

MIN ENG 6085 Internship (IND 0.0-15)
Students working toward a doctor of engineering degree will select, with the advice of their committees, appropriate problems for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the doctor of engineering degree.

MIN ENG 6099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

MIN ENG 6132 Advanced Mine Health And Safety Design (LEC 3.0)
Principles of design of mining operations with emphasis on the health and safety of the worker. Prerequisite: Graduate standing.

MIN ENG 6133 Mine Atmospheric Control II (LEC 3.0)
Climatic measurements and temperature precalculations, emergency plans for fan failures and mine fires, mine air contaminants, mine noises, mine dust, refrigeration and cooling plant layout, radiation control. Prerequisite: Min Eng 5113.

MIN ENG 6432 Advanced Mineral Engineering Design II (LAB 2.0 and LEC 1.0)
Incorporation of principles developed in Min Eng 6132 in advanced design projects for mineral plants and systems, with emphasis on environmental protection, health, and safety. Prerequisite: Min Eng 6132.

MIN ENG 6522 Mining Property Feasibility Studies And Evaluation Procedure (LAB 1.0 and LEC 2.0)
A systematic phased approach is presented, designed to increase the level of confidence and accuracy of estimates, moving from exploration through to a "bankable" study. Liability, ethics, resource/reserves, political/social/investment risk, economic parameters, and due diligence are discussed. Prerequisite: Min Eng 3512 or Geology 3511 or Min Eng 4742 or Geophys 3251.

MIN ENG 6532 Mine Management II (LEC 3.0)
The course covers advanced concepts in managing mine operations. Topics to be covered include TQM, statistical process control, benchmarking, KPI, standards and standardization, ISO 9000: Quality Control, ISO 14000: Environmental systems, OHSAS 18000. Management systems, SA8000, Social Accountability and others. Prerequisite: Consent of instructor.

MIN ENG 6622 Environmental Controls For Blasting (LAB 1.0 and LEC 2.0)
Advanced blast mechanics; overbreak control including comprehensive coverage of perimeter and smoothwall specialist blasting techniques and geotechnical factors affecting blast vibration, limits analysis monitoring and control; air blast control including limits, monitoring and atmospheric and topographic effects. Prerequisites: Min Eng 5612, Successful background check. (Co-listed with Exp Eng 6412).

MIN ENG 6632 Theory Of High Explosives (LEC 3.0)
Study of the application of chemical thermodynamics and the hydrodynamic theory to determine the properties of high explosives; application of detonation theory to steady-state detonations in real explosives; application of the above to the blasting action of explosives. Prerequisite: Graduate Standing; Math 1215, Chemistry 1310, Physics 1135, and either Exp Eng 5112 or Exp Eng 5612. (Co-listed with Exp Eng 6212).

MIN ENG 6712 Managing Social and Environmental Risks in Mining (Intro to Responsible Mining) (LEC 3.0)
This course is an introduction to responsible mining. It focuses on industry and NGO programs around sustainability and reporting in mining, financial community response, community of interest engagement and participation, and safety and crisis response and management. Prerequisites: Min Eng 4742 or Min Eng 5742.

MIN ENG 6735 Sustainability In Mining (LEC 3.0)
Sustainability defined: social, economic and environmental impacts. Mining as sustainable development interventions. Mine planning for sustainability, sustainability assessment and reporting, sustainable mine closure and post-mining land use. Case studies. Prerequisite: Min Eng 5742.

MIN ENG 6842 Advanced Rock Mechanics (LEC 3.0)
Advanced topics in static and dynamic rock mechanics; elasticity theory, failure theories and fracture mechanics applied to rock; stress wave propagation and dynamic elastic constants; rock mass classification methods for support design; pillar design in coal and metal mines; introduction to numerical models. Prerequisite: Min Eng 5823 or Civ Eng 3715.

MIN ENG 6843 Dynamic Rock Mechanics (LEC 3.0)
Advanced topics in dynamic rock mechanics. Stress ware propagation in the earth, dynamic elastic constants in isotropic and anisotropic rock, Hopkinson bar impact analysis, spallation and radial fracturing caused by stress pulses, shock ware generation in rock by explosives, shock ware propagation and effects. Prerequisite: Min Eng 5823 or Civ Eng 3715.

MIN ENG 6912 Advanced Simulation of Mining Systems (LEC 3.0)
Stochastic, discrete and discrete-continuous, Monte Carlo simulation. Model formulation using general purpose discrete-event simulation software. Model verification and validation. Simulation experimentation. Prerequisites: Stat 5643 or graduate standing.

MIN ENG 6922 Optimization Applications In Mining I (LEC 3.0)
Mining applications of deterministic optimization techniques are covered, including linear, integer, mixed-integer, dynamic, unconstrained and constrained nonlinear, and heuristic programming. Prerequisite: Graduate standing or consent.

MIN ENG 6923 Geostatistics (LEC 3.0)
Definition of geostatistical data; theory of random fields; autocorrelation and measures of spatial variability including semivariograms, variograms and covariance functions; and spatial prediction and validation. Case studies in mineral resource estimation and environmental pollutant prediction will be presented. Prerequisites: Graduate standing or consent of instructor.

MIN ENG 6932 Advanced Mining Systems (LEC 3.0)
Principles of design for the development and production of hard rock mineral deposits that require integrated surface and underground mining methods. Cost considerations leading to optimization. Terminal feasibility report required. Prerequisites: Min Eng 4932 and Min Eng 4933.

MIN ENG 6935 Underground Mine Design (LEC 3.0)
This course will focus on the determinants of underground mine design, geomechanical mine design for underground mining; mine optimization; mine environmental systems; and underground mine design and optimization. Prerequisite: Min Eng 4932 or equivalent.

MIN ENG 6936 Surface Mine Design (LEC 3.0)
This course will focus on the determinants of surface mine design, geomechanical and geometrical mine design for open pit and strip mining; mine layouts optimization; mine environmental systems; and research directions in surface mine design and optimization. Prerequisites: Min Eng 5933 or graduate standing.

MIN ENG 6992 Research Methods (LEC 3.0)
Foundations, dimensions, and methods for designing and investigating research problems. Focus on fundamentals and applied research, research methods, literature review, experimental design and experimentation, dissertation composition, concepts of originality and intellectual property. Prerequisites: PhD students only. (Co-listed with Exp Eng 6292).