

# MinE 382 – Mine Power Systems

## Fall Semester, 2011

Tuesday & Thursday, 9:30 a.m. – 10:45 a.m., Room 209 MRB

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- Instructor: Dr. Mark F. Sindelar  
Room 233 MRB (center office—in the Mine Design Lab)  
Mining Engineering Department, CEMR, WVU  
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- Office Hours: Open Door Policy or by appointment
- Prerequisites: Phys 112, MinE 205, MinE 206, or Instructor Approval
- Required Text: Morley, Lloyd A., 1981, Mine Power Systems, Volume I and Volume II, U.S. Bureau of Mines Open File Report, 1098 p.
- Introduction: This course provides the mining engineering student with the necessary knowledge, skills, tools, and ability to design a mine electrical power system. The course teaches the overall analysis and design of the power system as well as the individual analysis and design of the various sub-systems and their interrelationships. The course provides the student with numerous practical applications of mathematics, mechanics, and engineering to solve problems and design sub-systems and complete systems related to mine power. In addition, safety and troubleshooting topics common to electrical systems will be introduced to provide students entering the mining industry with an awareness of these critical issues.

### Expected Learning Outcomes:

By the end of the course, students will be able to:

1. Analyze direct current (DC) circuits including determination of voltage, current, and resistance.
2. Analyze single-phase and three-phase alternating current (AC) circuits including determination of impedances, power factor (and power factor correction).
3. Specify an appropriate electrical motor for a given application including the size, voltage, torque characteristics, construction, starting, and overload protection requirements.
4. Use tables to size underground distribution cables appropriate for the given equipment including current rating, type of construction, and grounding and shielding requirements.
5. Understand the resistance grounded neutral power system used in underground mining, including its operation and characteristics including ground fault and ground monitor systems. Be able to size grounding conductors and grounding resistors, and specify the design and operation of the ground fault detection and ground check systems.

6. Specify power centers and switch houses including transformer design and selection, KVA rating, circuits, fault protection, and power factor correction.
7. Understand the relaying and solid state equipment and used in mine power systems.
8. Understand the special operating conditions and requirements for battery operated equipment.
9. Understand the practical, legal, and economic constraints of mine power system design.
10. Complete a one-line diagram for a typical mine including all: substations, switch houses, power centers, major equipment, major cables, voltages, ampacities, grounding, etc.

<u>Grading:</u>	Homeworks & Quizzes	50%
	Attendance / Participation	10%
	Mid-Term Exams	20%
	Final Project	20%

<u>Grade Assignment:</u>	100 – 90	A
	89 – 80	B
	79 – 70	C
	69 – 60	D
	59 - 0	F

Attendance: It is expected that students will make every effort to attend class. Attendance will be taken and will be included in the Attendance/ Participation component, which comprises 10% of the final grade. Students may be absent from class with pre-approval.

Grading Policy: No make-up exams except by prior arrangement with instructor. Exam grading appeals must be submitted in writing on the day the exam is returned.

HW Assignments: Homework assignments and or quizzes will be given approximately every week and each assignment will be worth approximately the same credit. The sum of the homework assignments and quizzes will be worth 50% of the class grade. Late assignments will not be accepted. The lowest homework or quiz grade will be dropped.

Quizzes: Short quizzes to judge student preparedness and understanding will be given frequently throughout the class. The sum of the homework assignments and quizzes will be worth 50% of the class grade.

Final Project: A final design project will be given to each individual student at the mid-point of the term. The project will essentially consist of developing a comprehensive one-line electrical diagram of a typical mine with appropriate supporting documentation and calculations. The final project will be due the week before dead week, and will be worth 20% of the final grade.

Field Trip: In past semesters, one field trip has typically been scheduled to observe a functioning power system at an operating mine.

Attendance Policy: Consistent with WVU guidelines, students absent from regularly scheduled examinations or quizzes because of authorized University activities will have the opportunity to take them at an alternate time. Make-up exams or quizzes for absences due to any other reason will be at the discretion of the instructor.

Classroom Conduct: Since you are all professionals in training, I expect you to conduct yourself in a professional manner in this class. For instance, when the class is in progress, I expect everyone to remove their hats, put away the newspaper, turn off all electronic devices (*e.g.* cell phones), and refrain from eating, drinking, or smoking. Please do not force me to have to remind you that you should behave in a professional manner. Disruptive and unprofessional behavior will result in an unfavorable “Participation” component of your grade. Everyone is encouraged to ask questions and share personal experiences regarding electrical systems with which you have familiarity.

Professional Registration: As part of the academic and professional development of young mining engineers, the Mining Engineering Department strongly encourages student to take the Fundamentals of Engineering (FE) exam and to then follow this by becoming registered as a Professional Engineer (PE).

Social Justice Statement: West Virginia is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700).

Days of Special Concern: WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the Schedule of Courses. Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance. Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field

trips that a student misses as a result of observing a Day of Special Concern.

Academic Integrity: As a future professional, your academic and personal integrity is assumed. The WVU academic guidelines may be found at <http://www.arc.wvu.edu/admissions/integrity.html>

Course Schedule:

Week	Topic
1	History of Mine Power Systems, Electrical Safety
2	Electrical Theory, DC Circuit Analysis
3	DC Circuit Analysis, AC Circuit Analysis
4	Circuit Analysis – Lab on Circuit Analysis
5	Generators & Motors
6	Distribution, Cable Construction, and Sizing
7	Grounding, Ground Monitor Circuits
8	Design of Substations and Power Centers
9	Design of Power Centers, Fault Protection
10	Fault Protection and Relaying
11	Lab on Power Center Design and Fault Protection
12	Solid State Design
13	Solid State Applications in Mining
14	Batteries and Battery Power
15	Review Final Projects

\*In addition, some “special topics” will be introduced as schedule allows.