MinE 331: Mine Ventilation Engineering

A Required Course for Mining Engineering B.S. Program

Instructor:	**Yi Luo**, Ph.D. and PE, Associate Professor
Lecture Hours:	Tues & Thur, 5:00 -6:20 PM, ESB G84
Laboratory Hours:	Group 1: Wed, 4:00 PM; Group 2: Thu, 3:00 PM
Office Hours:	MRB 359A, Open door policy
Phone/E-mail:	293-3867/yi.luo@mail.wvu.edu
Credit Hours:	3
Prerequisites:	MinE 205 (Underground Mining Systems) MAE 331 (Fluid Mechanics - MAE)/CE 321 (Fluid Mechanics-Civil Engr)

Textbook: Hartman, H. L.; J. M. Mutmansky, R. V. Ramani,; and Y. J.Wang; 3rd Ed., 1997, *Mine Ventilation and Air Conditioning*, 3rd Ed., John Wiley & Sons, NY, 730 pp.

References:

1. Code of Federal Regulations, Title 30, Mineral resources, U. S. Government Printing Office, Washington, D.C. http://www.msha.gov/30cfr/0.0.htm
2. Hartman, H. L., Ed., 1992, "SME Mining Engineering Handbook," SME Littleton, Colorado, pp 989-1153.

Objectives: To familiarize the students with engineering principles, purposes, methods, and equipment applied to the management of ventilation system and working environment in underground mines.

Topics:

1. Basic gas thermodynamics
2. Components of Mine Ventilation Systems
3. Mine Ventilation Regulations, overview
4. Engineering Ethics
5. Dilution Requirements
6. Air Flow, Pressure Gradients
7. Head Losses, Air Power
8. Airway Resistances
9. Simple Ventilation Circuits
10. Controlled Splitting
11. Natural Ventilation
12. Fan Characteristics
13. Fan Applications
14. Complex Networks
15. Computer Aided Network Analysis
16. Auxiliary Ventilation
17. Economics of Airflow
18. Coal Mine Ventilation Systems
19. Gas Control
20. Dust Control
21. Mine Fires and Explosions

Laboratory Sessions:

1. Use of Vane Anemometer and Pitot Tube
2. Venturi Meters
3. Mine Pressure Survey and Shock Losses
4. Mine Characteristic Curve
5. Fan Characteristic Curve and Operating Points
6. Mine Ventilation Network Analysis

Engineering Ethics Report:

Each student will write a research report on the Westray or UBB Mine Disaster, focusing on areas where regulations were knowingly ignored or disobeyed, where ethical principles were violated, and the division of responsibility for these actions between owners, management, government, and labor.

Guided Design Project: Each student will be given a map of a small room-and-pillar coal mine and its related operation information. He/she is required to utilize the knowledge learned through the course

- To lay out a mine ventilation system and the necessary control devices, emergency escape routes
- To determine ventilation parameters (e.g., environment, ventilation requirements, airway resistances, natural ventilation, etc.)
- To select proper mine fan
- To perform network analyses of the ventilation system using a personal computer program

Grading:

Homework	35 %	Overall Grade (G)	Letter Grade
Ethics Report	5%	$G \geq 90$	A
Project Report	15 %	$80 \leq G < 90$	B
Laboratory	15 %	$70 \leq G < 80$	C
Exams (2)	30 %	$60 \leq G < 70$	D
Class attendance	±5%	$G < 60$	F

Expected Learning Outcomes

After taking this course, the students should have acquired the fundamental knowledge, techniques and ability to use software tools in common mine ventilation system design and analysis. He/she should be able to

- Determine the physical and psychrometric properties of ventilation air
- Know the important aspects of engineering ethic and the importance of PE license and paths to obtain a PE.
- Understand the health and safety effects of various mine gases and their regulatory limits. Use the air quality monitoring tools to measure the mine gases
- Understand the health and safety effects of mine dust
- Use the general energy laws in determining the ventilation heads in a mine ventilation system. Know the methods to determine resistances of airways and vent tubes.
- Simplify and solve simple ventilation network problems manually. Master the methods to distribute air quantities in parallel airways
- Understand the principles of formulating and solving mine ventilation network. Use MS Excel to formulate and solve a ventilation network problem. Use VnetPC software to simulate a complex mine ventilation system.
- Select and operate mine fans
- Determine natural ventilation in a mine
- Know the features of US coal mine ventilation system and methods to design

- Use the methods to design auxiliary ventilation system
- Detect and control mine fires
- Use various tools and techniques to measure air flow rates and pressure

Contribution of Course to Professional Component

Ventilation is a necessary operating component of any underground mining activity, and is essential not just for the operation but for the health and safety of the workforce involved. This course provides the skills needed to establish ventilation requirements and thereby design ventilation systems based on:

- regulatory requirements
- health concerns for workers
- levels of dusts and toxic or explosive gases present
- mining methods used
- splitting and delivery of different quantities of air to various workplaces, as required

This course especially ensures that students understand how to forecast such need and subsequently calculate power requirements for delivery, and design a system that will provide ventilation as it is needed. The capstone of this course is learning to use VnetPC, the most commonly used mine ventilation design software used in industry today.

Relationship of Course to Program Outcomes

This course contributes to the overall engineering knowledge required to design, construct, and operate an underground mine. It provides applications of mathematics and various mine design methods. It provides experience in considering multiple mining systems simultaneously, as would be needed in the field. It also provides an examination of engineering ethics as applied to mine operational decision-making, by examining a mine ventilation disaster in Canada, the Westray explosion.