MONTANA TECHNOLOGICAL UNIVERSITY

Mine Ventilation

COURSE LEVEL OBJECTIVES

- **CO1** - **Differentiate** mine ventilation principles and their application in underground mining operations.
- **CO2** - **Comprehend & Evaluate** design, operation, and maintenance of ventilation systems and equipment.
- **CO3** - **Acquire and Apply** knowledge and skills to monitor and control air quality in underground mines.
- **CO4** – **Investigate** and **Analyze** strategies for managing heat, humidity, dust, and gas hazards in underground mining environments.
- **CO5- Explain** the sensitivity of ventilation circuits and models to address ventilation circuits, networks, and issues related to mine safety.
- **CO6- Demonstrate** critical thinking and problem-solving skills through case studies and practical exercises.

COURSE MODULES

1. **M1** – Introduction to Mine Ventilation
2. **M2** – **Psychrometrics**
3. M3- Mine Air-Quality Control
4. **M4** – Airflow through Mine Openings and Ducts
5. **M5** – Ventilation Measurements and Surveys
6. **M6** – Mine Ventilation Circuits and Networks
7. **M7** – Natural Ventilation
8. **M8** – Air-Moving Equipment
9. **M9** – Fan Application to Mines
10. **M10** – Auxiliary Ventilation and Controlled Recirculation
11. **M11** – Mine Ventilation Systems
12. **M12** – Mine Air Conditioning
13. **M13** – Ventilation Legislation, Safety, and Statutory Requirements

Course Final Project
Design a comprehensive ventilation system for an underground mine. This project will include: 1. **Assessment of Ventilation Requirements**: Analyzing the mine layout, production rates, and environmental conditions to determine the ventilation needs. 2. **System Design**: Creating a detailed design of the ventilation network, including primary and auxiliary fans, ducting, and airways. 3. **Simulation and Modeling**: Using software to simulate airflow, temperature, and gas concentrations to ensure the system meets safety and efficiency standards. 4. **Energy Efficiency Analysis**: Evaluating the energy consumption of the ventilation system and proposing methods to optimize energy use. 5. **Health and Safety Considerations**: Assessing the impact of the ventilation system on worker health and safety, including dust and gas control. 6. **Cost Analysis**: Estimating the costs associated with the installation and operation of the ventilation system. 7. **Implementation Plan**: Developing a step-by-step plan for the installation and commissioning of the ventilation system.

MODULE 1: Introduction to Mine Ventilation OBJECTIVES
M101- Explain the fundamental principles of mine ventilation. **CO1** **M102**-Describe the historical development and significance of mine ventilation in underground mining. **CO2** **M103**-Identify the key components and functions of a mine ventilation system. **CO3**

MODULE 1 ACTIVITIES and ASSESSMENTS	
ACTIVITIES (SUGGESTED)	**ASSESSMENTS**

• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Assignment- Final SCAFFOLD every other module.** • **Alternative assignment** • **Quiz**	1. Quiz 2. Discussion 3. H5P flash cards or memorization activity with assessment 4. Other

MODULE 2: Psychrometry **OBJECTIVES**
M201-Interpret and analyze psychrometric properties of air using dry-bulb temperature, wet-bulb temperature, relative humidity, and dew point, with reference to the psychrometric chart. **M202-** Apply psychrometric principles to assess thermal comfort and evaluate the impact of moisture and temperature conditions in underground mine environments. **M203-** Calculate enthalpy changes and moisture content in ventilation airflows to support decisions on air cooling, heating, and dehumidification in mine ventilation design.

MODULE 2 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow	1. Discussion 2. Assignment 3.Quiz

mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	

MODULE 3: Mine Air Quality Control **OBJECTIVES**
M301-Assess the factors affecting air quality in underground mines. **CO2** **M302**- Evaluate methods for monitoring and controlling dust, gases, and other contaminants. **CO4** **M303-** Implement strategies to ensure compliance with air quality standards and regulations. **CO5**

MODULE 3 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

MODULE 4: Airflow through Mine Openings and Ducts **OBJECTIVES**

M401-Analyze the principles of airflow dynamics in mine openings and ducts.
M402-Calculate airflow rates and pressure losses in various mine ventilation scenarios.
M403- Design and optimize duct systems for efficient air distribution in mines.

MODULE 4 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

14. **MODULE 5: Ventilation Measurements and Surveys**

OBJECTIVES

M501-Conduct ventilation surveys to measure airflow, pressure, and gas concentrations.
M502-Interpret ventilation survey data to assess the effectiveness of ventilation systems.
M503-Develop recommendations for improving ventilation based on survey results.

MODULE 5 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture**	1. 1. Discussion 2. 2. Assignment 3. 3.Quiz

• **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	

15. **MODULE 6: Mine Ventilation Circuits and Networks**
OBJECTIVES
M6O1 – Explain the structure and function of mine ventilation circuits and networks. **M6O2** - Analyze the sensitivity of ventilation circuits to changes in operational conditions. **M6O3** - Design and troubleshoot ventilation circuits to enhance mine safety and efficiency.

MODULE 6 ACTIVITIES and ASSESSMENTS	
	ASSESSMENTS
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

16. **MODULE 7: Natural Ventilation**
OBJECTIVES
M7O1 - Describe the principles of natural ventilation in underground mines. **M7O2** - Evaluate the factors influencing natural ventilation effectiveness. **M7O3-** Implement natural ventilation strategies to complement mechanical ventilation systems.

MODULE 6 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

MODULE 8: Air-Moving Equipment OBJECTIVES
M8O1 - Identify different types of air-moving equipment used in mine ventilation. **M8O2** - Evaluate the performance characteristics of various fans and blowers. **M8O3** -

MODULE 8 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

MODULE 9: Fan Application to Mines OBJECTIVES
M9O1- Explain the role of fans in mine ventilation systems. **M9O2** - Analyze the performance curves of different types of fans. **M9O3-** Design and optimize fan installations for effective mine ventilation.

MODULE 9 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

MODULE 10: Auxiliary Ventilation and Controlled Recirculation OBJECTIVES
M10-O1 - Describe the need for auxiliary ventilation in underground mines. **M10-O2** - Evaluate methods for implementing controlled recirculation in mine ventilation **M10-O3** - Design auxiliary ventilation systems to address specific ventilation challenges.

MODULE 10 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents	1. Discussion 2. Assignment 3.Quiz

to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	

MODULE 11: Mine Ventilation Systems **OBJECTIVES**
M11-O1 - Explain the components and operation of integrated mine ventilation systems. **M11-O2** - Evaluate the design and performance of different ventilation system configurations. **M11-O3** - Develop and implement comprehensive ventilation plans for underground mines.

MODULE 11 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

17. **MODULE 12: Mine Air Conditioning** **OBJECTIVES**
M12O1 - Describe the principles and applications of mine air conditioning. **M12O2** - Evaluate the effectiveness of different air conditioning methods in controlling heat and humidity. **M12O3** - Design and implement air conditioning systems to improve mine working conditions.

MODULE 112ACTIVITIES and ASSESSMENTS

ACTIVITIES	ASSESSMENTS
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz

MODULE 13: Ventilation Legislation, Safety, and Statutory Requirements OBJECTIVES
M13O1 – Identify key legislation and regulations governing mine ventilation. **M13O2** – Evaluate the impact of safety standards on ventilation system design and operation. **M13O3** - Ensure compliance with statutory requirements through effective ventilation management.

MODULE 13 ACTIVITIES and ASSESSMENTS	
ACTIVITIES	**ASSESSMENTS**
• **Reading** • **Interactive Lectures:** Use diagrams, flowcharts, and animations to illustrate ventilation concepts, pollutant sources, and airflow mechanics. **Lightboard- OR Panopto recorded lecture** • **Discussion Forum -Case Studies:** Introduce real-world mining incidents to highlight the critical role of ventilation in safety. • Review definitions and concepts- **H5P- Flash cards** • **Quiz**	1. Discussion 2. Assignment 3.Quiz Final
