GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Mining Engineering
Subject Code: BE05022021
Subject Name: Mine Ventilation

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core Course

Prerequisite:	Nil
Rationale:	The course provides comprehensive knowledge of mine ventilation systems and environmental control practices essential for safe and efficient mining operations. It emphasizes principles of airflow, mine gases, dust control, ventilation planning, monitoring techniques, mine cooling, and disaster management. Students gain an understanding of ventilation network design, fan performance, auxiliary ventilation systems, and statutory provisions governing mine ventilation to maintain healthy underground working conditions.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Understand the fundamentals of mine ventilation, mine atmosphere, and properties of air.	15
CO-2	Analyze airflow distribution, pressure losses, and ventilation network systems in mines.	20
CO-3	Understand environmental, labor welfare, and occupational health legislation applicable to mines.	25
CO-4	Apply knowledge of mine fans, auxiliary ventilation, and ventilation planning for safe mining operations.	20
CO-5	Understand mine ventilation legislation, monitoring and emergency ventilation practices.	20

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	SL	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	TW/ SL (I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

Content:

Sr. No.	Content	Total Hrs.
1	**Introduction to Mine Ventilation:** Composition and properties of atmospheric air; mine air standards; physical properties of air; humidity, temperature, density and pressure relationships; mine atmosphere and environmental conditions; causes and effects of poor ventilation; requirements of ventilation in underground mines; natural ventilation and mechanical ventilation.	**08**
2	**Airflow Mechanics and Ventilation Networks:** Fundamentals of airflow; Atkinson's equation; frictional losses in airways; equivalent orifice concept; series and parallel ventilation circuits; splitting of air currents; pressure losses due to shock and bends; ventilation network analysis; methods of air quantity measurement; ventilation calculations and balancing of air distribution.	**10**
3	**Mine Gases and Dust Control:** Occurrence, properties, physiological effects, detection, and monitoring of mine gases including methane, carbon monoxide, carbon dioxide, hydrogen sulphide, oxides of nitrogen, and oxygen deficiency; explosibility limits and flame safety lamps; methane drainage techniques; sources and classification of mine dust; dust sampling and measurement; dust suppression and control methods; pneumoconiosis and occupational health hazards.	**10**
4	**Mine Fans and Auxiliary Ventilation:** Main mechanical ventilators; centrifugal and axial flow fans; fan characteristic curves; fan laws; operating point and fan performance; booster and auxiliary fans; ventilation devices including stoppings, regulators, air crossings, doors, and brattices; auxiliary ventilation systems for development headings; forcing, exhaust and overlap systems; fan testing and efficiency determination.	**09**
5	**Heat, Cooling and Mine Air Conditioning:** Sources of heat in mines; physiological effects of heat and humidity; effective temperature and comfort indices; heat stress assessment; methods of mine cooling; refrigeration systems; spot cooling and centralized air conditioning systems; ventilation requirements in deep mines.	**04**
6	**Ventilation Planning, Monitoring and Legislation:** Ventilation surveys; use of anemometers, barometers, hygrometers, gas detectors and dust samplers; computer applications in ventilation planning; ventilation standards	**04**

	and statutory provisions under Coal Mines Regulations and Metalliferous Mines Regulations; mine fires, explosions and emergency ventilation control; rescue and recovery operations related to mine ventilation.	
	TOTAL	**45**

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35	**40**	**15**	**10**	**00**	**00**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

The syllabus of Mine Surveying – II directly contributes to:

SDG 4	Quality Education
SDG 9	Industry Innovation and Infrastructure
SDG 12	Responsible consumption
SDG 13	Climate action
SDG 15	Life of Land

Reference Books:

S. No.	**Titles**	**Author(s)**	**Publisher and Edition with ISBN**
1.	Mine Ventilation and Air Conditioning	Howard L. Hartman	Wiley Publications
2.	Environmental Engineering in Mines	Vutukuri & Lama	Cambridge University Press
3.	Mine Ventilation	G. B. Mishra	Lovely Prakashan
4.	Mine Environment and Ventilation	S. K. Das	Oxford University Press
5.	Subsurface Ventilation Engineering	Malcolm J. McPherson	Springer

Listof Experiments:

6.	Principles of Mine Ventilation	T.C. Cantrill	Mining Publications
7.	Mine Fires, Explosions, Rescue & Recovery Operations	C. P. Singh	Lovely Publications
8	SME Mining Engineering Handbook	Peter Darling	SME Publications

1. Study and demonstration of various mine ventilation instruments, including anemometer, barometer, hygrometer, vellometer, and gas detector.
2. Measurement of air quantity and air velocity in mine airways using a vane anemometer and calculation of airflow parameters.
3. Determination of pressure losses due to friction in ventilation ducts and verification of Atkinson's equation.
4. Study of ventilation network circuits in series and parallel and determination of equivalent resistance of airways.
5. Performance testing of centrifugal and axial-flow mine fans and plotting of fan characteristic curves.
6. Determination of operating point, fan efficiency, and verification of fan laws for mine ventilators.
7. Measurement and analysis of mine gases using gas detection instruments and flame safety lamp demonstration.
8. Dust sampling, dust concentration measurement, and study of dust suppression techniques in mines.
9. Study and design of auxiliary ventilation systems for underground development headings using forcing and exhaust arrangements.
10. Ventilation survey of a mine ventilation model/network and preparation of a ventilation plan with airflow balancing calculations.

Major Equipment:

i. Total Station
ii. Vane Anemometer
iii. Hot Wire Anemometer
iv. Digital Velometer
v. Barometer
vi. Hygrometer / Sling Psychrometer
vii. Manometer (U-tube and Inclined Type)
viii. Mine Ventilation Demonstration Model
ix. Axial Flow Fan Setup
x. Centrifugal Fan Setup
xi. Ventilation Duct and Airflow Test Rig
xii. Pitot Tube Apparatus
xiii. Gas Detection Instruments (CH_4, CO, CO_2, O_2 Detectors)
xiv. Multi-Gas Analyzer
xv. Flame Safety Lamp
xvi. Dust Sampler / Personal Dust Sampler
xvii. Dust Monitoring Instrument (Respirable Dust Monitor)

xviii. Smoke Tubes for Airflow Direction Study
xix. Ventilation Network Simulation Software
xx. Fan Characteristic Curve Test Setup
xxi. Heat Stress Monitoring Instrument / Kata Thermometer
xxii. Refrigeration and Mine Cooling Demonstration Unit
xxiii. Air Quantity Measuring Devices
xxiv. Auxiliary Ventilation Fan with Ventilation Tubing
xxv. Mine Fire and Explosion Demonstration Model
xxvi. Computer System with Ventilation Planning Software

Open-Source Software/learning website:

1. https://nptel.ac.in/courses/123106002
2. https://www.youtube.com/results?search_query=mine+ventilation+engineering
3. https://www.youtube.com/watch?v=MdgnIVsOOmg&list=PLR-ilwyMnghWM3IOkxgOcr-Fkd_jZoiPo

List of suggested activities for Problem-based Learning (PBL):

Sr. No.	PBL category	Name of the activity	No. of hours	Evaluation Criteria
1.	Complex Problem-Solving targeting relevant SDGs / Mini Project	Mini Project	10h (need to be changed as per total PBL hours)	Based on the novelty of project, technical understanding, report quality and presentation
2.	Case Study Analysis / Seminar	Seminar	15h (need to be changed as per total PBL hours)	Based on the quality of report and presentation, technical understanding
3.	Micro project	Micro project	5h (need to be changed as per total PBL hours)	Based on the novelty of project, technical understanding, quality of report and demonstration
4.	Industry/Research laboratory visit	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
5.	Video Based Learning	Technical video-based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
6.	Assignment / Technical Writing / Research Writing	Assignment writing. Numerical based	5 assignments of 4 h each Total = 20h	Based on the correctness of submitted assignment

		assignment is preferable.		
7.	Group Discussion / Quiz / Simulation	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB, modeling and Analysis software or any other software	5 small coding-based assignment of 2h each Total = 10h	Based on the coding solution submitted.
8.	Video Based Learning	Self-learning online course	Minimum duration of the course should be 10h	Examination based assessment at the end of course. Based on the certificate produced.
9.	Complex Problem-Solving targeting relevant SDGs / Mini Project	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
10.	Video Based Learning	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
11.	Research Paper Review / Analysis	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20h	Summarize research paper and evaluation critical parameters
12.	Poster / Chart / PowerPoint presentation	Poster/chart/power point preparation on technical topics	Duration = 6h	Based on poster/chart preparation and presentation skills
13.	Industry/Research laboratory visit	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any	Duration = 15h for industrial exposure Problem identification and tentative solution = 10h Total = 20h	Based on evaluation of critical problems and solutions

		other issue		
14.	Group Discussion / Quiz / Simulation	Group Discussion on emerging/trending technical topics based on subject	Duration = 1h – 3h per topic	Based on performance in group discussion, technical depth, knowledge etc.
15.	Case Study Analysis / Seminar	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
16.	Group Discussion / Quiz / Simulation	Application/Software development	Duration = 10h	Depending on the complexity of the Application/Software
17.	Assignment / Technical Writing / Research Writing	Research paper publication	Duration = 10h	Based on submission of proof of publication
18.	Micro project	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10h	Based on the performance of the equipment
19.	Industry/Research laboratory visit	Expert lecture/session	Duration 3h For attending the lecture/session– 2h and for report writing 1h	Based on the proof of attendance and report submitted
20.	Video Based Learning	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
21.	Assignment / Technical Writing / Research Writing	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.
22.	Assignment / Technical Writing / Research Writing	Preparation of a report on Indian Standard(s)	10h (study of Indian Standard(s) + report	Based on report quality and understanding of the relevant Indian Standard(s).

List of suggested activities for Term Work / Self Learning:

a. Assignments: (Seminar Topics/ Visits/Self-Learning Topics) Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.)

i. Prepare a ventilation layout for an underground mine.
ii. Calculate air quantity requirements for different underground workings.
iii. Study and compare different types of mine fans and their applications.
iv. Analyze methane monitoring and dust suppression practices in mines.
v. Visit an underground mine and prepare a report on ventilation arrangements.

b. Micro Projects:

A Suggested list of course-wise micro-projects is mentioned herewith
i. Design a simple mine ventilation network for an underground coal mine.
ii. Prepare a comparative study of auxiliary ventilation systems used in development headings.
iii. Develop a safety management plan for controlling mine gases and dust hazards.
iv. Prepare a case study on mine fire and explosion incidents related to ventilation failures.

Note:
1. Mini Project – 10 Marks , Micro Project – 5 Marks
2. The hours allocated to specific activities should be proportionate to the total no. of PBL hours and marks.

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