GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Mining Engineering
Subject Code: BE05022071
Subject Name: Mine Hazard and Rescue

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	Basics of Mining Engineering: Mine Legislation
Rationale:	This course provides comprehensive knowledge of mine hazards, disaster management, emergency response, and mine rescue operations in surface and underground mines. It emphasizes the identification, prevention, monitoring, and control of mining hazards, including fires, explosions, inundation, strata failures, dust, gases, and machinery accidents. The course also develops an understanding of rescue equipment, emergency preparedness, risk assessment, communication systems, and modern rescue technologies, all essential to ensuring safe and sustainable mining operations.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Understand various mine hazards, their causes, effects, and preventive measures in mining operations.	20
CO-2	Apply hazard identification, risk assessment, and disaster management techniques in mines.	20
CO-3	Analyze mine fire, explosion, inundation, strata control, and gas hazards for safe mine operations.	25
CO-4	Understand mine rescue organization, rescue equipment, and emergency response procedures.	20
CO-5	Apply modern safety monitoring systems, communication technologies, and sustainable rescue practices in mining industries.	15

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	PBL	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	PBL (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 Hazards and Risk Assessment:** Classification of mine hazards; causes and effects of mining accidents; hazard identification techniques; risk analysis and assessment; accident investigation; safety audits; hazard control hierarchy; occupational health and safety management systems in mines.	**08**
2	**Mine Fires, Explosions and Gas Hazards:** Causes and classification of mine fires; spontaneous heating and combustion; fire prevention and firefighting methods; explosion hazards due to methane and coal dust; explosibility limits; explosion barriers; gas detection and monitoring systems; ventilation control measures.	**10**
3	**Inundation, Strata and Machinery Hazards:** Causes and prevention of mine inundation; water dams and barriers; strata control hazards; roof falls and slope failures; monitoring techniques; machinery and electrical hazards; transport and haulage accidents; preventive and protective measures.	**09**
4	**Mine Rescue and Emergency Management:** Mine rescue organization and functions; rescue stations and brigades; breathing apparatus and rescue equipment; first aid and emergency medical response; rescue communication systems; mine emergency preparedness plans; disaster management practices; rescue operations in fire, explosion, inundation, and collapse situations.	**10**
5	**Modern Trends in Mine Safety and Rescue:** Automation and remote monitoring in mine safety; IoT and sensor-based hazard monitoring; drone applications in mine rescue; GIS and GPS applications; refuge chambers; real-time communication systems; artificial intelligence in safety prediction; sustainable and smart mine safety systems.	**08**
	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
20	**25**	**35**	**10**	**10**	**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 Hazard and Rescue directly contributes to:

SDG 4	Quality Education
SDG 8	Decent Work and Economic Growth
SDG 9	Industry Innovation and Infrastructure
SDG 11	Sustainable Cities and Communities
SDG 13	Climate action

Reference Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Mine Disasters and Mine Rescue	S. Ghatak	CRC Press, S
2.	Mine Disasters and Mine Rescue	M. A. Ramlu	Universities Press, Second Edition, 8173715734, 978-8173715730
3.	Mine Environment and Ventilation	M. A. Ramlu	Oxford & IBH
4.	Principles of Mining Safety and Health	J. L. Weeks	MaGraw-Hill
5.	Mine Safety and Rescue Engineering	D. MacDonald	SME 9783838373812
6.	Mine Health and Safety Management	M. Karmis	Society for Mining, Metallurgy, and Exploration, 2001. 0873352009
7.	Mine Rescue Rules and Guidelines	DGMS	Government of India Publications
8.	Accident Reports and Safety Guidelines	DGMS Circulars	Government of India Publications

List of Experiments:

1. Study of mine rescue organization and rescue procedures.
2. Demonstration of breathing apparatus and gas masks.
3. Detection and monitoring of mine gases using gas detectors.
4. Study of mine firefighting equipment and techniques.
5. Risk assessment and hazard analysis exercises.
6. Mock drill for underground mine emergency response.
7. First aid and CPR training for mine emergencies.
8. Study of refuge chambers and communication systems.
9. Analysis of mine accident case studies.
10. Simulation of disaster management and rescue operations.

Major Equipment:

i. Self-Contained Breathing Apparatus (SCBA)
ii. Gas Detection Instruments
iii. Flame Safety Lamps
iv. Firefighting Equipment and Extinguishers
v. First Aid and CPR Training Kits
vi. Mine Rescue Communication Systems
vii. Rescue Stretchers and Safety Gear
viii. Refuge Chamber Demonstration Unit
ix. Smoke Chamber Training Setup
x. Mine Safety Monitoring Sensors
xi. Ventilation Demonstration Models
xii. Mine Disaster Simulation Software

Open-Source Software/learning website:

1. DGMS (Directorate General of Mines Safety)
2. NPTEL Mining Engineering Courses
3. ILO Safety and Health in Mines Resources
4. MSHA (Mine Safety and Health Administration)
5. SME Mining Engineering Resources
6. National Disaster Management Authority (NDMA)
7. CDC-NIOSH Mining Program
8. Virtual Mine Rescue Training by MSHA
9. YouTube Mining Safety Tutorials
10. Scilab Open Source Software

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	15h (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	8h (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 assignment is preferable.	5 assignments of 4 h each Total = 20h	Based on the correctness of submitted assignment
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	Identification and solution of	Maximum 2 problems. Study of the problem and solution	Based on the depth of the solution submitted.

	relevant SDGs / Mini Project	Complex problem	finding, Total = 10h	
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 other issue	Duration = 15h for industrial exposure Problem identification and tentative solution = 10h Total = 20h	Based on evaluation of critical problems and solutions
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	Duration 10h	Based on the performance of the equipment

		laboratory		
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. Study causes and preventive measures of mine fires.
ii. Prepare risk assessment reports for mining operations.
iii. Analyze major mine disaster case studies.
iv. Compare conventional and modern mine rescue systems.
v. Study safety monitoring technologies used in mines.

b. Micro Projects:

A Suggested list of course-wise micro-projects is mentioned herewith
i. Develop a mine emergency preparedness plan.
ii. Prepare a layout of underground refuge chamber systems.
iii. Conduct hazard mapping for surface or underground mines.
iv. Design a communication flowchart for rescue operations.
v. Prepare a case study on AI-based mine safety systems.

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