



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mining Engineering

Subject Code: DI04022031

Subject Name: Underground Metal Mining

w. e. f. Academic Year:	2025-26
Semester:	4 th
Category of the Course:	PCC

Prerequisite:	Basic Mining Terminology, Mining Machinery, Explosive, Basic knowledge of blasting procedure, Basic Geology
Rationale:	<p>Metal extraction was started from the ancient times in the history of first civilization. Metal is the prime requirement for economic growth and development of any nation. Underground Metal Mining plays a vital role in ensuring the sustainable supply of metals essential for industrial, technological, and economic development. This course provides students with comprehensive knowledge of underground mine development, excavation techniques, and extraction methods suited to different ore deposits. It emphasizes the distinction between unsupported, supported, and caving methods of stopping, highlighting the principles, applications, and limitations of each. By studying various mine layouts, terminologies, and excavation practices, students will develop a strong foundation in underground mining engineering.</p> <p>The course aims to prepare students for practical challenges in Indian mining industries by integrating theoretical knowledge with operational aspects of safety, productivity, and efficiency in underground metal mining operations.</p>

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes	RBT Level
01	Differentiate underground metal mining with coal mining and identify major ore deposits in India.	R, U
02	Describe mine development methods, access systems, and excavation techniques.	R, U
03	Classify and compare different stoping methods used in underground mining.	R, U
04	Describe and compare various open stoping methods and their applications.	R, U



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05	Explain supported stoping techniques and their relevance to safety and stability.	R, U
06	Describe different caving methods and their applicability in large-scale ore extraction.	R, U

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA (M)	PA (I)	ESE (V)	
4	0	0	4	70	30	0	0	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Underground Metal Mining: 1.1 <i>Definition:</i> Rock, Mineral, Ore 1.2 Metals in antiquity 1.3 Metals in Industrial Civilization 1.4 Present status of ore deposit and Mining in India 1.5 Major Underground metal mining industries across India 1.6 Difference between Underground Metal and Coal Mining	04	7
2.	Mine Development: 2.1 Introduction 2.2 <i>Types of Deposit:</i> Vein deposit, Massive deposit, Bedded Deposit, Outcrop 2.3 <i>Terminology:</i> <i>Access to deposit:</i> Adit, Incline, Decline, Shaft: Vertical and Inclined and their comparison; Hang wall, Foot wall, Cross cut, Drift/Drive, Level, Raise, Winze, Staple pit/shaft, Shaft Station, Ramp, Ore pass, Waste pass, Chute, Ore bin, Waste bin, Man-pass/Manway, Stope, Stopping,	18	30



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	2.4 Level Interval and the Factors Influencing It 2.5 <i>Horizontal Drivage</i> : Drilling pattern: Burn cut and Wedge cut, Cycle of operation (Including Auxiliary Operations) 2.6 <i>Vertical Drivage: Raise</i> 2.5.1 Introduction and purpose 2.5.2 Raise driving techniques: Classification; Open raising, Compartment method, Alimak raise climber, Jora Hoist, Long hole raising, Drop raising, Raise borer 2.7 <i>Vertical Drivage: Winze</i> ; Introduction and Drivage technique		
3.	Stoping Method: 3.1 Factors governing choice of a stoping method 3.2 Classification of stoping methods 3.3 Terminology: Sill Pillar, Crown Pillar, Undercut, Over cut, Bell, finger raise, grizzly level, Draw point, Haulage drift/Transport drift, Rib pillar, Slot raise, Service raise	03	5
4.	Unsupported/Open stoping method: 4.1 Overhand stoping 4.2 Underhand stoping 4.3 Breast stoping 4.4 Room and Pillar stoping 4.5 Shrinkage stoping 4.6 Sub level stoping 4.7 Blast hole stoping: VCR method	17	28
5.	Supported Stoping method: 5.1 Stull stoping 5.2 Cut and Fill stoping 5.3 Square set stoping	09	15
6.	Caving methods: 6.1 Sublevel caving 6.2 Block caving 6.3 Top slicing	09	15
Total		60	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20	80	0	0	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Tatiya, R.R. Surface and Underground Excavations (2nd Edition). CRC Press
2. Hartman, H.L. Introductory to Mining Engineering. John Wiley & Sons.
3. Deshmukh, D.J. Elements of Mining Technology (Volume 2). Central Techno Publication.
4. Chacharkar, Y.P. A study of Metalliferous Mining Methods. Lovely Prakashan

(b) Open-source software and website:

1. NPTEL: Underground Mining of Metalliferous Deposits, IIT Kharagpur
nptel.ac.in/courses/123105006
2. Horizontal Drivage
<https://www.youtube.com/watch?v=G2Hs51QDszc>
<https://www.youtube.com/watch?v=bjByaLdfPgM> (also Ore Pass)
https://www.youtube.com/watch?v=UG6YOPy_tOQ
3. Raising by Alimak Raise Climber
<https://www.youtube.com/watch?v=oMD1mmrWbWc>
4. Raising by Raise Boring
https://www.youtube.com/watch?v=0h_Zi5BNUPA
<https://www.youtube.com/watch?v=0Vgi7rHNvXw>
5. Room and Pillar Stopping method
<https://www.youtube.com/watch?v=Oaxs7EEIp4k>



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6. Sublevel Stopping method
<https://www.youtube.com/watch?v=BdU6-DvnpVU>
7. Cut and Fill Stopping method
https://www.youtube.com/watch?v=M9A_Gybcf3U
8. Sublevel Caving method
<https://www.youtube.com/watch?v=ZmKwdtFkoxo>
9. Block Caving method
<https://www.youtube.com/watch?v=MWqMD85MVO4>

Suggested Project List:

1. Prepare a comparative chart of metal vs. coal mining methods.
2. Prepare a chart comparing various stopping methods.
3. Demonstrate ore handling from stope to surface with diagram.
4. Design posters on underground mining safety rules (supports, blasting safety, PPE).
5. Surf different websites related to new technologies in metal mining industry and make a report.

Suggested Activities for Students:

1. Visit a nearby underground metal mine and prepare a short technical report.
2. Sketch mine layouts showing shaft, incline, winze, raises, and ore passes.
3. Group Discussion: Advantages and limitations of different stopping methods.
4. MCQ Test: On terminology and stopping methods.
