

MN-105 Elements of Mining Engineering

Course Title	Elements Of Mining Engineering	Course Code	MN-105
SEMESTER	I Year	Course Group	Core
Teaching Scheme in periods (L : T : P)	4:1:0	Credits	3.0
Methodology	Lecture + Tutorial	Total Contact Periods	150
CIE	60 Marks	SEE	40 Marks

Prerequisites: This course requires the basic knowledge of basic Physics, Mathematics and social studies at Secondary school level

Course outcomes: After successful completion of this course, the students will able to

CO1	Understand the scope of minerals and mining in modern society.
CO2	Choose the safe and economic mode of entry and method of extraction of deposit.
CO3	Perform shaft sinking at various site conditions in safe and economic aspects.
CO4	Choose the best methods of drilling according to site conditions.
CO5	Select the right type of explosives and handle with safe mode of practice.
CO6	Perform the blasting operations in mines.

COURSE CONTENT

Unit-1 Introduction to Mining.

Duration: 26 HOURS

Various definitions of Mining- Mining operations-Historical overview of mining, Classification of minerals based on their use in our day-to-day life - Importance of Minerals in our day to day life - role of mining industry in nation economy-Contribution of mining to human civilization- Indian mineral resources and world status -role of mining engineers in mining industry-Statutory organizations and their role in mining industry- Mining Industries in the state and in the country - Classify Mineral Reserves - Stages of life of mine.

Unit-2 Concepts of Mining Methods

Duration: 24 HOURS

Definitions used in Mining methods -Out crop, over-burden, vein, Ore, Ore deposits, Waste / Gangue - Gradient, Convert Gradient to angle in degrees vice versa-Classification of coal seams based on the thickness depth, inclination, gassiness - Classify the mining methods, selection of underground and surface mining, Comparison - Modes of entry into the deposit-application, limitations, staple pit, cross measure drift.

Unit-3 Shaft sinking

Duration: 24 HOURS

Shape of shafts - pilot core in site selection, factors for selection of site, equipment required for sinking a shaft, Rider, Spider and walling scaffold and water garland - different stages of sinking through subsoil, temporary, permanent supporting, tubbing - Drilling, Blasting patterns used during shaft sinking, Ventilation and lighting system while sinking shaft -special methods of shaft sinking-widening and deepening of shaft.

Unit-4 Drilling methods

Duration: 26 HOURS

Define drilling, uses of drill holes, operating components of the drilling system - mechanism of rock drilling - classification of drilling methods-Principle of working - motive power method of selection, application, limitations -Various drill tools, drill bits and their field application - flushing methods-feed mechanism - mechanism of percussive drilling, rotary drilling - rotary-percussive drilling - variables affecting the performance of drilling - why drilling need feed mechanism - Methods of core recovery - reasons for deviation of bore holes, bore hole survey.

Unit-5 Explosives for mines

Duration: 26 HOURS

Define the term Explosive, Detonation, Deflagration, Magazine and Reserve station - constituents of explosives - Properties of explosives - Classify explosives - high explosives, low explosives - Detonator and Booster - Classify the detonators - composition and construction of electric delay detonators - electronic detonators - cap sensitive and non-cap sensitive explosives - Bulk explosives - Cartridge - Permitted explosive - Absolute bulk strength and Absolute weight strength - Relative bulk strength and relative weight strength -Reserve station - magazine.

Unit-6 Blasting practice in mining

Duration: 24 HOURS

Blasting in mines - fragmentation of rock - alternates of blasting in fragmentation of rock - Blast hole”, Burden, Spacing, Stemming - Misfire hole, Blown out shot, Socket and Fly rock - Blasting Pattern - parameters need to consider while selecting blasting pattern - blasting patterns use in underground mines - blasting initiators - applications of safety fuse, detonating fuse and Nonel, cord relay - Primed cartridge - accessories and tools used in blasting operation - direct initiation and inverse initiation - Blasting of solid in underground coal mines - series and parallel connections - Calculate the resistance of given blasting circuit - resistance of electric circuits in blasting - Calculate powder factor of round of blast holes - procedure to perform blasting operation in underground mines - deal with misfire shot holes in underground mines.

Reference Books:

- 1) Elements of Mining Technology - Vol-I, D.J. Deshmukh, Denett publication
- 2) Elements of Mining Technology - Vol-II, D.J. Deshmukh, Denett publication
- 3) Surface and underground excavations - Ratan Raj Tatiya.
- 4) Coal mining practice – I.C.F Statham Vol-I The Caxton Publishing Company Limited, London.
- 5) Principles and practices of modern coal mining - By R.D Singh.

Suggested learning outcomes:

CO-1 Understand the scope of minerals and mining in modern society.

- 1.1. Define the terms- Mine, Mining, Mining Engineer, Mineral, Rock.
- 1.2. State the Historical overview of mining.
- 1.3. Classification of minerals (Metallic, non-Metallic, energy minerals).
- 1.4. State the Application of minerals in modern technology, infrastructure and daily life.
- 1.5. Explain the role of mining industry in nation economy.
- 1.6. State the Indian mineral reserves and their world ranking.
- 1.7. State the role of mining engineers in mining industry.
- 1.8. List the various statutory organizations and their role in mining industry(DGMS, IBM).
- 1.9. List various laws applicable to mining industry.
- 1.10. List the Major & Minor Public and Private sector existing companies across the State, Country.
- 1.11. What is resource and reserve.
- 1.12. Differentiate between mineral resource and mineral reserve.
- 1.13. Classify Mineral Reserves (United Nations Framework Classification).
- 1.14. State proved, probable and possible reserves.
- 1.15. Explain feasibility report of a mine project.
- 1.16. State the various permission required to start and run a mine.
- 1.17. Calculate life of a mine with a suitable example.
- 1.18. State the factors considered to calculate life of a mine.
- 1.19. Explain the Life of Mine calculation with a suitable example.
- 1.20. Explain importance of critical minerals and rare earth minerals in nation building.
- 1.21. State governments policy related to critical and rare earth minerals in India.
- 1.22. State the critical minerals and rare earth minerals reserves in country and world.
- 1.23. List the Stages of life of mine.
- 1.24. Explain Pre-Mining stage Operations.
- 1.25. Explain Mining stage Operations.
- 1.26. Explain Post Mining stage Operations.

CO-2 Choose the safe and economic mode of entry and method of extraction of deposit.

- 2.1 Define the terms Coal seam, Vein, Outcrop, Over-burden with neat sketches.
- 2.2 Define the terms Ore, Orebody, Gangue, Grade, Cutoff grade and Dilution.
- 2.3 Give the classification of coal seams based on the thickness, depth and inclination.
- 2.4 Define Degree-I gassy seam, Degree-II gassy seam and Degree-III gassy seam
- 2.5 Define the term Gradient of a drivage in mine and how to express it.
- 2.6 Convert Gradient to angle in degrees vice versa.
- 2.7 Classify the mining methods.

- 2.8 Define the term Gestation period, Coal mine, oil mine and metal mine.
- 2.9 Define Underground mining and Surface mining.
- 2.10 State the conditions for selection of underground and surface mining.
- 2.11 Compare underground mining versus opencast mining.
- 2.12 List different types of mode of entry to mineral deposits.
- 2.13 Define the term Adit, Incline, Decline and Shaft with neat sketches.
- 2.14 State the applicability of various mode of entries to deposits.
- 2.15 State the site selection of incline as mode of entry to deposit.
- 2.16 Explain the construction and drivage of incline entry.
- 2.17 State the advantages and disadvantages of various mode of entries to deposits.
- 2.18 Compare incline versus shaft mode of entry into mineral deposits.
- 2.19 Compare incline versus adit mode of entry into mineral deposits.

CO-3 Perform shaft sinking at various site conditions in safe and economic aspects.

- 3.1 List the types of shape of shafts.
- 3.2 Why we are mostly selecting circular shape shafts in mines.
- 3.3 State the factors consider for selection of a site for shaft sinking.
- 3.4 What is the importance of pilot core in site selection for shaft sinking.
- 3.5 List the necessary equipment required for sinking a shaft.
- 3.6 State the purpose of Rider, Spider and walling scaffold and water garland.
- 3.7 Explain the stages of sinking of shaft through normal strata.
- 3.8 Explain auxiliary operations in shaft sinking.
- 3.9 State the purpose of temporary lining in sinking shaft.
- 3.10 Explain the permanent supporting of the shaft sides.
- 3.11 What is tubbing and applications of tubbing in shaft sinking.
- 3.12 Classify the special methods of shaft sinking and their applicability.
- 3.13 State the applicability of a) Pilling Method b) Caission Methods c) Freezing Method
d) Cementation Method.
- 3.14 Explain the Pilling method of shaft sinking.
- 3.15 State the sinking drum (Open caission) method of shaft sinking.
- 3.16 State the Forced drop caission method of shaft sinking.

- 3.17 State the Pneumatic caisson method of shaft sinking.
- 3.18 Explain the Freezing method of shaft sinking.
- 3.19 Explain the Cementation method of shaft sinking.
- 3.20 State the purpose of widening and deepening of existing shaft.
- 3.21 Explain the widening process of shaft.
- 3.22 Explain the deepening of the shaft sinking.
- 3.23 Calculate production per blast in sinking shaft.

CO-4 Choose the best methods of drilling according to site conditions.

- 4.1 Define the term Drilling.
- 4.2 State the uses of drilling for various purposes.
- 4.3 Explain the operating components of the drilling system.
- 4.4 List different types of drill bits.
- 4.5 Explain mechanism of rock drilling.
- 4.6 Give the classification of drilling methods based on principle.
- 4.7 Give the classification of drilling methods based on motive power.
- 4.8 Give the classification of drilling methods based on drill mounting.
- 4.9 State the selection of various Drilling methods.
- 4.10 State the applications of percussive and rotary drilling methods.
- 4.11 What is flushing of bore hole?
- 4.12 State the various flushing methods and their application.
- 4.13 List the drilling tools and accessories and their application.
- 4.14 Explain mechanism of percussive drilling with sketch.
- 4.15 Explain mechanism of rotary drilling with sketch.
- 4.16 Explain mechanism of rotary-percussive drilling with sketch.
- 4.17 What is exploratory drilling and production drilling.
- 4.18 Explain the variables affecting the performance of drilling.
- 4.19 Why drilling need feed mechanism and state the types.
- 4.20 Define the terms sludge and core.
- 4.21 State various core sample size.
- 4.22 State the purpose of core recovery.

- 4.23 What is core barrel in core recovery.
- 4.24 List the types of core barrels and applications.
- 4.25 What is bore hole logging and state its purpose.
- 4.26 What is the meaning of deviation of bore hole.
- 4.27 What are the various methods to measure deviation of bore holes.
- 4.28 State the reasons for deviation of bore holes.

CO-5 Select the right type of explosives and handle with safe mode of practice.

- 5.1 Define the terms “Explosive, Detonation, Deflagration, Magazine and Reserve station”.
- 5.2 Explain the common ingredients of explosives.
- 5.3 List the Properties of explosives.
- 5.4 Explain the Properties of explosives.
- 5.5 Classify the explosives as per Petroleum and Explosives Safety Organization (PESO).
- 5.6 What is high explosive and low explosive.
- 5.7 List the high explosives uses in mines.
- 5.8 List the low explosives and their composition uses in mines.
- 5.9 Why we preferring high explosive and why not low explosives in mines.
- 5.10 Define the terms Detonator and Booster.
- 5.11 Classify detonators based on the method of initiation.
- 5.12 What is long delay and short delay.
- 5.13 Explain the composition and construction of electric delay detonators.
- 5.14 Explain the composition and construction of electronic detonators.
- 5.15 Explain the principle of electronic delay detonator.
- 5.16 State the important features of electronic detonators.
- 5.17 List the types of electronic detonators.
- 5.18 Compare electric vs electronic detonators.
- 5.19 Define the term cap sensitive and non-cap sensitive explosives.
- 5.20 Define the terms “Cartridge” explosive and “Bulk explosives”.
- 5.21 List the Bulk explosives used in surface mines.
- 5.22 What are the advantages of bulk explosives over cartridge explosives.
- 5.23 State the composition and construction of booster explosive.
- 5.24 Define the term ‘Permitted explosive’.
- 5.25 Classifies the Permitted explosives and their applicability

- 5.26 State the test that a permitted explosive should pass through.
- 5.27 Define Absolute bulk strength and Absolute weight strength.
- 5.28 Define Relative bulk strength and relative weight strength.
- 5.29 Calculate Relative bulk strength and Relative weight strength of explosive.
- 5.30 What is Reserve station.
- 5.31 What is magazine and list its types.
- 5.32 Analyse the safety features need to follow at magazine.

CO-6 Perform the blasting operations in mines.

- 6.1 Define the term “blasting” in mines.
- 6.2 State the need of blasting in mines.
- 6.3 What is fragmentation of rock.
- 6.4 What is good fragmentation and poor fragmentation.
- 6.5 Choose the alternates of blasting in fragmentation of rock.
- 6.6 Define the terms “Blast hole”, Burden, Spacing, Stemming.
- 6.7 Define the terms “Misfire hole, Blown out shot, Socket and Fly rock.
- 6.8 What is Blasting Pattern.
- 6.9 What are the parameters need to consider while selecting blasting pattern.
- 6.10 List various blasting patterns use in underground mines.
- 6.11 Choose the best blasting pattern for given site conditions.
- 6.12 State why initiator must in blasting practice.
- 6.13 What is Primed cartridge.
- 6.14 List various accessories and tools used in blasting operation.
- 6.15 State the applications of various blasting tools and accessories.
- 6.16 Explain direct initiation and inverse initiation.
- 6.17 Explain the conditions and procedure of Blasting of solid in underground coal mines.
- 6.18 Explain blasting card system followed in below ground blasting.
- 6.19 State the applications of series and parallel connections in blasting.
- 6.20 Why we need to find the resistance of electric circuits in blasting.
- 6.21 Calculate the resistance of given blasting circuit.
- 6.22 What is powder factor and detonating factor.
- 6.23 Calculate powder factor and detonating factor of round of blast holes.
- 6.24 Illustrate the procedure to perform blasting operation in underground mines along with safety precaution's to be taken.
- 6.25 Apply the procedure to deal with misfire shot holes in underground mines.

Suggested students activities:-

1. Students should visit the mine and observe the difference in theory and actual practice at the mine
2. Students should listen to NPTEL course for depth of knowledge.
3. Quiz in class on completed topics.
4. Group discussions and debates over topics.
5. Surprise test

E- learning Resources

1. <http://www.miningmagazine.com/>
2. <http://www.mining-journal.com/country/india>
3. <https://www.cmpdi.co.in/publication.php>
4. www.nptel.ac.in

CO - PO MATRIX:

	Basic and Discipline Specific Knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation and Testing	Engineering Practices for Society, Sustainability and Environment	Project Management	Lifelong Learning	Linked PO
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Mapping POs
CO1	3	0	0	0	0	1	0	1,6
CO2	3	2	1	1	1	0	1	1.2.3.4.5.7
CO3	3	3	2	1	1	2	2	1.2.3.4.5.6.7
CO4	3	3	2	2	2	2	3	1.2.3.4.5.6.7
CO5	3	3	2	2	2	2	3	1.2.3.4.5.6.7
CO6	3	3	2	2	2	2	3	1.2.3.4.5.6.7

Level-3-Highly Addressed, Level-2-Moderately Addressed, Level -1-Low Addressed

Internal Evaluation

Test	Units	Marks
Mid 1	1 and 2	20
Mid 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS

The length of answer for each question framed in respect of Part-A, B&C shall not exceed $\frac{1}{4}$ of a page, 1 page and 2 pages respectively

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

MID - I EXAM

S.No	Unit No	R	U	A	Remarks
1	Unit-I	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-II	3,4	6(a)	8(a)	
			6(b)	8(b)	
Total Questions		4	4	4	

MID - II EXAM

S.No	Unit No	R	U	A	Remarks
1	Unit-III	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-IV	3,4	6(a)	8(a)	
			6(b)	8(b)	
Total Questions		4	4	4	

QUESTION PAPER PATTERN FOR SEMESTER END EXAM

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Legend: R-Remembering, U-Understanding, A-Applying

BOARD DIPLOMA EXAMINATION
Diploma in Mining Engineering,
I Year, Mid - I Examination
Elements of Mining Engineering (MN-105)

Model paper

TIME :1 Hours

Max. Marks: 20

PART – A

4 X1 = 4

NOTE: 1) Answer **all** questions and each question carries **one** mark.

2) Answers should be brief and straight to the point and shall not exceeding **three** simple sentences

1. Define the term mine.
2. List the various statutory organizations in mining industry.
3. Define the term “gestation period”.
4. The main incline of the mine is driven 30° from horizontal. Convert it to gradient.

PART – B

NOTE: Answer **all** questions . Each question carries **three** marks

2X3 =6

5. (a) State the historical overview of mining.
OR
5. (b) Classify the minerals based on their use in our day to day life.
6. (a) Classify the coal seams based on depth and inclination.
OR
- 6 (b) What are the point need to consider while selecting site for mode of entry.

PART – C

NOTE: Answer **all** questions. Each question carries **five** marks

2X5 = 10

- 7 (a) Explain the role of mining industry in nation economy.
OR
- 7 (b) Explain pre-mining stage of mine life .
- 8 (a) Compare underground vs surface mining in any 10 aspects.
OR
- 8 (b) Explain various mode of entries to mineral deposits with neat sketch.

BOARD DIPLOMA EXAMINATION
Diploma in Mining, I year
Mid - II Examination
Elements of Mining Technology (MN-105)

Model paper

Time : 1 hr

Total Marks : 20

PART – A

4 X1 = 4

NOTE: 1) Answer **all** questions and each question carries **one** mark.

2) Answers should be brief and straight to the point and shall not exceeding **three** simple sentences

1. Why mostly circular shafts selects.
2. State the purpose of Rider.
3. List different types of drill bits.
4. State the purpose of flushing of bore holes..

PART – B

2 X 3 = 6

NOTE: Answer **all** questions . Each question carries **three** marks

5 (a) State the purpose of temporary lining

OR

(b) State the purpose of widening and deepening of existing shaft.

6. (a) What is exploration drilling and production drilling.

OR

(b) State the reasons for deviation of bore holes.

PART – C

2 X 5 = 10

NOTE: Answer **all** questions . Each question carries **five** marks

7. (a) Explain the Pilling method of shaft sinking.

OR

(b) Explain the Freezing method of shaft sinking.

8. (a) Explain the mechanism of percussive drilling with neat sketch.

OR

(b) Explain the operating components of the drilling system.

BOARD DIPLOMA EXAMINATION

END EXAM

MODEL PAPER

Elements of Mining Engineering (MN-105)

TIME :2 Hours

Max. Marks: 40

PART – A

8 X1 = 8

NOTE: 1) Answer **all** questions and each question carries **one** mark.

2) Answers should be brief and straight to the point and shall not exceeding **three** simple sentences

1. List various ferrous metals used in day to day life.
2. What is the meaning of deviation of bore hole.
3. Define the term “ Detonation”.
4. State the purpose of water garland.
5. Define the term ‘Permitted explosive’.
6. List the high explosives uses in mines.
7. What is fragmentation of rock.
8. What is Blasting Pattern.

PART – B

NOTE: Answer all questions . Each question carries three marks

9(a) List the various mining industries in the state and in the country.

OR

9(b) Classify the detonators based on its composition.

10(a) What is tubbing and state where to apply tubbing in shaft sinking.

OR

10(b) Choose the best blasting pattern for drifts and state why.

11(a) What are the advantages of bulk explosives over cartridge explosives.

OR

11(b) Classify the Permitted explosives and state when to be use the P5 explosives.

12(a) Choose the alternates of blasting to fragmentation of rock.

OR

12(b) Where to apply direct initiation and inverse initiation

PART – C

4X5 = 20

NOTE: Answer **all** questions . Each question carries **five** marks

13 (a) State the role of mining engineers in mining industry.

OR

(b) Explain the safety features/ guidelines need to follow at magazine

14(a) Explain the Cementation method of shaft sinking.

OR

(b) State the applications of various blasting tools and accessories.

15 (a) Explain the composition and construction of electric delay detonators.

OR

(b) An explosive with a density of 1.2 g/cm³ has a heat of explosion equal to 900 cal/g. if the heat of explosion of ANFO with density of 0.8 g/cm³ is 950 cal/g. Calculate the bulk strength of explosive related to ANFO.

16 (a) Explain the conditions and procedure of Blasting of solid in underground coal mines.

OR

(b) Apply the procedure to deal with misfire shot holes in underground mines
