



# SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

## Syllabus

**Course:** Diploma  
**Semester:** V

**Branch:** Mining and Mine Surveying  
**Academic Session:** 2024-25

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## SUBJECT – MINE ECONOMICS AND MINERAL PROCESSING

SUBJECT CODE – DMI051

### Course Objective

The objective of this course is to provide students with a comprehensive understanding of the economic principles and mineral processing techniques that are vital for the successful management of mining operations. Students will learn to assess the economic value of mineral resources, apply sampling and processing methods, and manage financial and operational aspects of mining.

#### Unit 1: General Economics

Economic Terms - Wealth, Value, Goods, Price; Wants-wants and economic activities, classification of wants: (a) Law of diminishing utility, (b) Law of equi-marginal utility; Utility- meaning, measurement, marginal and total Utility; Demand- Definition, demand Schedule and demand curve, Law of demand curve, Extension and contraction in demand, Increase and decrease in demand, Elasticity of demand; Supply- Supply price, Supply Schedule, Supply curve, Supply function, Law of supply, Elasticity of supply; Capital- Definition, Characteristics of capital, Importance and function of capital; Money- Definition of money, Function of money, Classification of money.

#### Unit 2: Mine Economics

Mineral Industry – Its role in national economy, Indian Mineral resources and their statistics, Mineral Policies, Conservation of minerals including Coal Company; Constitution of companies under companies Act, Types of companies, Private and public sectors, merits and demerits, Government Undertakings; Labour – Efficiency of labour, Labour welfare, Social security, Trade Unions.

#### Unit 3: Sampling

Principles of Sampling, Methods, Error, Selection of Sampling procedure for Particular deposits, Preparation of sample, Coning and Quarter Splitting methods of reduction of samples; Salting method of salting, Salting methods by mistakes/errors. Purposeful salting procedures, Safe procedures for collecting sample to guard against purposeful salting, Average stoping width, willing width of mining, clear width, Average width, Simple average, Weightage average, Mean values, Mining grade of ore, economical grade, cutoff grade of ores, cut off grades of samples and stops.

#### Unit 4: Valuation and Depreciation

Methods of valuation by different methods of annuity, Calculation of different annuities, Methods of depreciation and calculation of Depreciation methods of calculations of Redemption values, Main valuation methods of mining Property which under production, Valuation under different methods, Report of valuation of small mining property.

#### Unit 5: Ore Dressing

Important methods of ore dressing, their classification and their role in Mining Industry, Preparation of ore for ore dressing, crusher, cone crusher, their construction working limit, size, grading of ore, introduction to (a) Tabling (b) Spanning (c) Gravity (d) Separation (e) Magnetic separation, (f) Flootation cell.



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### Course Outcomes

- CO1** Identify the role of important mineral based industry in national economy viz-a-viz country's national mineral policy.
- CO2** Carry out the computation and classification of reserve and grade estimation.
- CO3** Identify methods of sampling for different types of deposits and recognize salting.
- CO4** Calculate the value of mineral properties and estimate the depreciation.
- CO5** Identify book keeping system and ore dressing.

### Textbooks:

1. Industrial Economics - By V.C. Sinha and pushpa sinha
2. Mineral economics - By R.K. Sinha and N.L. Sharma.
3. Mineral and mine Economics - R.T. Deshmukh.
4. Engineering Economics – Tarachand



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## SUBJECT – MINE MACHINERY

SUBJECT CODE – DMI052

### Course Objective

The objective of this course is to equip students with an in-depth understanding of the machinery used in mining operations, from haulage and transport systems to face mechanization equipment. Students will gain knowledge of the selection, operation, maintenance, and safety practices associated with mine machinery. This course will enable students to analyze and optimize the performance and safety of machinery in various mining operations.

### Unit 1: Transport of Ore

Different types of haulages, Description of Direct rope haulage, Endless rope haulage, Main and Tail rope haulage, Gravity haulage, Calculation of rope haulage; Safety devices used on rope haulage system – Stop block/Buffers, Back stay, Monkey catch, Jazz rail, Runaway Switch, and Drop Warwick; Locomotive Haulage – Different types and its applicability: Diesel locomotive, Electric locomotive, Air compressed locomotive, and Battery locomotives; Conveyor system –Chain conveyor, Belt conveyor, Applicability, Advantages and disadvantages of each type; Introduction to Aerial Ropeways – Bicable and Monocable, advantages and disadvantages.

### Unit 2: Wire Ropes

Construction of wire ropes, different types of wire ropes – Stranded rope, Non stranded rope, Lays of rope – Lang's lay and ordinary lay, Different definition like static load, dynamic load, factor of safety; Selection of wire rope, Care and maintenance of ropes, Types of deterioration in the ropes, Testing of wire ropes; Rope capping - White metal capping (cone socket type capel), Wedge type capping (Reliance rope capel), Capping with split capel and rivets (Split capel), Recapping, Rope splicing – importance & procedure.

### Unit 3: Winding in Shaft

Purpose of Winding, Main equipments used for Winding – Head gear, Headgear pulley, Cage, Skip, Winding drum, Guides, Keps, Suspension Gear, Electric motor, Different types of winding – Drum winding & Koepe Winding; Drum winding – Different types, safety provisions on winding drum, Depth indicator, Mechanical Brakes (different types), Automatic Contrivance; Angle of fleet, Guides used in mines: Rigid guides & Flexible guide; Cage attachment to winding rope: Rope capel, D link and bull chain, Safety hook-king safety hook its construction and working, Triangular distribution plate; Different types of keps, Safety devices used in winding; Koepe winding – description, advantages and disadvantages.

### Unit 4: Mine Pumps

Sources of water in Mines, Classification of Mine Pumps: Reciprocating Pump, Centrifugal Pumps, Turbine Pumps, and Roto pump, Installation of pump, Operation of pump, Fitting on pump, Starting and stopping of pump, Characteristics Curves of Centrifugal and turbine pumps, Calculations for pump discharge & efficiency of pump.

### Unit 5: Electric Power Supply

Types of cable used in mines: Permanent cable, Semi flexible cable, and flexible cable, Screening of cable, Cable joint box, storage and maintenance of cables; Gate End Box: Construction of gate end box, Safety provision in gate end box, Pilot Circuit, Different protection circuits.

### Unit 6: Face Mechanisation

Construction, advantages, disadvantages and applicability of machineries likes: Continuous miners, Drum Shearer, LHD, SDL & Power Support; Electric coal drill machine – construction and working.



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### Course Outcomes

- CO1** Understand and describe various types of haulage systems used in mining operations. Understand the use of different locomotives and conveyor systems for ore transport.
- CO2** Comprehend the construction and types of wire ropes. Understand different types of deterioration and testing methods for wire ropes.
- CO3** Understand the purpose and main equipment used for winding in mines. Analyze different types of winding systems.
- CO4** Identify the sources of water in mines and classify different types of mine pumps. Understand the installation, operation, and maintenance of pumps.
- CO5** Understand the types of cables used in mines. Learn about gate end boxes, their construction, safety provisions, and pilot circuits.
- CO6** Analyze the construction, advantages, disadvantages, and applicability of various face mechanisation equipment. Understand the construction and working of electric coal drill machines to optimize face mining operations.

### Textbooks:

1. Elements of mining vol III – D.J. Deshmukh
2. Mine pumps, haulage & winding - S.Ghatak
3. Mining Coach III A Mine machinery - Arvind kumar
4. Mine Transport – Karelin



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## **SUBJECT – ROCK MECHANICS AND GROUND CONTROL**

SUBJECT CODE – DMI053

### **Course Objective**

The objective of this course is to provide students with an advanced understanding of rock mechanics and ground control techniques applied to mining operations. The course will cover the behavior of rocks under stress, rock strength properties, and methods to control strata in underground mining environments. By the end of the course, students will be able to design safe and effective ground control systems, analyze rock behavior under various stress conditions, and implement measures to mitigate risks such as rock bursts and strata failure.

### **Unit 1: Introduction to Rock Mechanics**

Concept of stress and strain in rock, stress due to weight of strata, vertical and lateral stresses, Stress due to tectonic and organic force, Residual stresses, Induced stresses, Field stresses, modulus of elasticity, poisson's number, Poisson's ratio, stress fields, introduction to elementary rock mass classification based on strength, hardness, RQD, Bieniawski RMR classification.

### **Unit 2: Rock Mass Properties**

Strength Properties: Compressive strength, Tensile Strength, Shear Strength, Flexural Strength; Strength Indices – Point Load Strength index, Impact Strength index, Protodykonov strength index. Rebound hardness, insitu stress by flat jack; Cohesion, Young's modulus, poisson's ratio; Porosity, Density, Moisture content, permeability; Material Characteristics: Brittle material, Ductile material, Elastic material, Plastic material; Time dependent properties: creep, Creep curve, factors contributing Creep. Deformation, weatherability.

### **Unit 3: Rock Testing**

Uniaxial compressive strength, Tensile strength – Brazilian test, Bending test; Shear strength test – punch shear test, Direct shear test on Rock cube, Triaxial method; Determination of strength indices – point load strength index, Protodykonov strength index, impact strength index.

### **Unit 4: Rock Burst and Bumps**

Rock burst, Bumps, causes controlling measures, factors affecting proneness to rock burst/Bumps; Pillar Design: factors considered. Pillar design by tributary area approach, determination of factor of safety.

### **Unit 5: Ground Control**

Theories of mechanics of strata behavior: Dome or arch theory, Beam theory; Timber supports: props. Chocks, supports of galleries, haulage road, prop free Front, Withdrawal of supports; Steel Supports, Theory of roof bolting, Function of roof bolts, Varieties of Roof Bolts - Slot and Wedge, Expansion shell, Grouted Roof Bolts, Resin Roof Bolts, Anchorage Testing of Roof Bolts. Roof stitching, Cable Bolting.



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### Course Outcomes

- CO1** Understand the fundamental concepts of stress and strain in rocks. Apply knowledge of stress fields, modulus of elasticity, Poisson's ratio, and rock mass classification systems.
- CO2** Analyze the strength properties of rocks. Determine strength indices and evaluate rock properties.
- CO3** Perform and interpret various rock tests including uniaxial compressive strength, Brazilian tensile strength test, bending test, and shear strength tests.
- CO4** Understand the causes and controlling measures for rock bursts and bumps in mining environments.
- CO5** Apply theories of strata behavior mechanics, such as dome or arch theory and beam theory, to ground control in mining. Understand the theory and function of roof bolting.

### Textbooks:

1. Rock Mechanics by Obert and Duvall
2. Rock Mechanics by Goodman
3. Rock Mechanics by Jager & Cook
4. Rock Mechanics by B.S. Verma



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## SUBJECT – METALLIFEROUS MINING

SUBJECT CODE – DMI054

### Course Objective

The objective of this course is to provide students with a comprehensive understanding of metalliferous mining operations, including the exploration, development, and extraction processes. The course covers various mining methods, equipment, and operational procedures, with a focus on safety, efficiency, and compliance with regulatory standards.

#### Unit 1: Basic concept of Metal Mining and Development of Mineral Deposits

Ore and gangue, hanging wall, foot wall, ore pass, ore bin, ore chute, raise, winze, comparison between coal and metal mines; dividing mineral ore body, levels, formation of blocks, shaft station, levels into sub levels, winzes and raises, positions of are drives, footwall, laying initial haulage, haulage inclines, ore passes, ore bin, chutes, handling waste rock, hand drills and air legs, drifters and jumbos, tunnel boring, arrangements for loadings and hauling of broken rock speeding up of winzing, conventional and mechanised methods of raising, jora rise method.

#### Unit 2: Stopping Methods

Open stopping methods, underhand, overhand, breast stopping, sublevel stopping, blast hole stopping, vcr, shrinkage method, their conditions of applicability, sequence of development, stopping operation, cycle of operations.

#### Unit 3: Supported and Caving Methods

Artificially supported methods cut and fill, square set, stulled stopping methods, their applicability, stope preparation, stopping operation, cycle of operation, relative merits and demerits etc.; caving methods – top slicing, sublevel caving and block caving methods, applicability, stope preparation, cycle of operation etc.; provisions of mmr 1961 regarding means of access and egress, ladders and ladder ways.

#### Unit 4: Shaft Sinking

Size, shape, factors considered for location of shaft, marking center, and shaft-centering arrangement; ordinary sinking up to rock head, sinking of shaft below rock head – operation of drilling, charging and blasting and mucking operation. Disposal of debris; shaft lining: temporary lining, permanent lining of shaft: brick, monolithic, reinforced concrete lining, shaft tubing's etc., walling scaffold, rider.

#### Unit 5: Special Methods of Shaft Sinking

Different special methods of shaft sinking – cementation method, freezing method, drop shaft method, condition and applicability of each method, description etc., widening and deepening of shaft.



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### Course Outcomes

- CO1** Understand the fundamental concepts of metal mining. Compare the operational aspects of metal mining with coal mining.
- CO2** Classify and choose appropriate stoping methods based on ore body characteristics and mining conditions.
- CO3** Understand and apply artificially supported stoping methods. Analyze their applicability, stope preparation, operations, and cycle of operations to determine their relative merits and demerits.
- CO4** Design and implement shaft sinking operations by considering size, shape, and location factors.
- CO5** Understand and apply special shaft sinking methods including cementation, freezing, and drop shaft methods.

### Textbooks:

1. A Study of metalliferous mining methods. – Y.P. Chacharkar
2. Elements of mining technology vol. II - D.J. Deshmukh
3. Mine working vol. I & II – H.N. KARMAKAR
4. Surface Mining Technology – S.K. DAS



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## SUBJECT – ADVANCE MINE SURVEYING

SUBJECT CODE – DMI055

### Course Objective

The objective of this course is to provide students with in-depth knowledge and practical skills related to advanced mine surveying techniques. It covers modern methods of traversing, triangulation, curve ranging, tacheometry, correlation surveys, and the application of advanced surveying technologies such as GPS, Total Station, and EDM.

#### Unit 1: Theodolite Traversing

Methods of traversing, by continuous azimuth method, included angles & deflection angle, checks in closed & open traverse, traverse computation: latitude, departure, consecutive coordinates, independent coordinates, error of closure adjustment of closed traverse, balancing by bowditch and transit rule, permanent adjustments of theodolite.

#### Unit 2: Triangulation Survey

Definition and principle of triangulation survey, classification of triangulation survey, fixing of stations, selection of site for base line, sequence of preparation before base line measurement. Equipments required for base line measurement, measurement of base line, correction required in base line measurement, prolongation of a base line, adjustments of horizontal angles, colliery triangulation, precautions in measuring angles and base line.

#### Unit 3: Setting Out Curves

Definition, types of curves – normal, compound, and reverse, nomenclature of a simple circular curve, elements of simple survey (circular), degree of curve, classification of curve ranging method, methods of simple circular curve ranging, chain & tape method - by successive bisection of arc, by taking perpendicular off sets from tangents, by taking perpendicular off sets from long chord, chord and off set method, instrumental methods- chord and angle method. (tangential angle method), by taking angles from single station. (ranking method), by taking angles two stations, u/g curve ranging methods - chord & off set method, chord & angle method.

#### Unit 4: Tacheometry

General, stadia diaphragm and its principle, theory of anallactic lens, determination multiplying and additive constant. Tachometric survey numerical problems

#### Unit 5: Correlation Survey

Purpose of correlation survey, classification of methods of orientation, direct method of traversing, assumed bearing method (two shaft method), exact alignment method, approximate alignment method, weissquadrilateral method, precise magnetic method, correlation with national grid and local scale factor.

#### Unit 6: Advances in Mine Surveying

Global positioning system – principle, the system, application in opencast mine surveying, advantages and disadvantages, total station – description, application in distance measurement, angle measurement, electronic distance measurement – principle of measurement, types etc., gyro theodolite – principle of gyro, gyro attachments laser plummet.



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### Course Outcomes

- CO1** Apply methods of traversing using theodolites. Apply error of closure adjustments and balance traverses. Understand and implement permanent adjustments of theodolite.
- CO2** Understand and apply the principles of triangulation survey. Implement colliery triangulation techniques and adhere to precautions in measuring angles and base lines to ensure survey accuracy.
- CO3** Understand and apply different types of curves used in mining surveys, including normal, compound, and reverse curves. Apply instrumental methods such as chord and angle method, tangential angle method, and two-station angle method.
- CO4** Understand the principles of tacheometry and the use of stadia diaphragm and anallactic lens.
- CO5** Understand the purpose and significance of correlation surveys in mining. Implement correlation techniques with national grid systems and local scale factors to ensure accurate alignment and positioning in mining surveys.
- CO6** Explore and apply advanced surveying technologies in mining, including GPS, total station, EDM, gyro theodolites, and laser plummets.

### Textbooks:

1. Mine Surveying vol. I, II & III - - S. Ghatak
2. Surveying & Levelling vol. II - Kanetkar & Kulkarni
3. Surveying vol. II - B.C. Punmia



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### SUBJECT – MINE MACHINERY LAB

SUBJECT CODE – DMI052P

**S. No.**                    **List of Experiments** (*At least Ten experiments are to be performed by each student*)

- 1        Study of different types of rope haulage.
- 2        Demonstration of different models of safety devices uses on rope haulage.
- 3        Demonstration of different types of drum winder models.
- 4        Demonstration of different parts in cage suspension gear and their function.
- 5        Demonstration of different types of Rope sample and their identification.
- 6        Study of Rope splicing method.
- 7        Study of different types of reciprocating pumps.
- 8        Study of different types of Centrifugal pump.
- 9        Study of Roto Pump.
- 10      Identification of different types of Electrical power cables used in mine.
- 11      Study of gate and box and its different circuits
- 12      Sketch and describe LHD.
- 13      Sketch and describe SDL.
- 14      Sketch and describe continuous miner.



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## SUBJECT –ROCK MECHANICS AND GROUND CONTROL LAB

SUBJECT CODE – DMI053P

### S. No.

### List of Experiments

- 1 Determination of uniaxial compressive strength of a rock sample.
- 2 Determination of tensile strength (Brazilian test) of a rock sample.
- 3 Determination of shear strength. of a rock sample.
- 4 Demonstration of triaxial cell.
- 5 Determination of point load strength index.
- 6 Determination of Protodykonov strength index.
- 7 Determination of impact strength index.
- 8 Demonstration of use of flat jack for insitu stress determination.
- 9 Demonstration of various Rock bolts.
- 10 Study of anchorage testing of rock bolts.
- 11 Demonstration of cable bolting.



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## SUBJECT – METALLIFEROUS MINING LAB

SUBJECT CODE – DMI054P

### S. No.                    **List of Experiments** *(At least Ten experiments are to be performed by each student)*

- 1      Sketch & describe various Metal Mining Terms.
- 2      Sketch & describe Sublevel stoping method.
- 3      Sketch & describe Shrinkage stoping method.
- 4      Sketch & describe Cut & fill stoping method
- 5      Sketch & describe Caving method (any one)
- 6      To sketch and describe the square set timbering
- 7      Sketch & describe Various systems of ore drawing from stope.
- 8      Sketch & describe Temporary lining in shaft.
- 9      Sketch & describe Permanent Brick lining in shaft.
- 10     Sketch & describe Concrete lining in shaft.
- 11     Sketch & describe Shaft tubbings.
- 12     Sketch & describe Special method of shaft sinking.
- 13     Sketch & describe Widening and deepening of shaft.



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### **SUBJECT – ADVANCE MINE SURVEYING LAB**

SUBJECT CODE – DMI055P

<b>S. No.</b>	<b>List of Experiments</b> <i>(At least Ten experiments are to be performed by each student)</i>
1	Sketch and describe Electronic Theodolite
2	To traverse an area by included angle method
3	To traverse an area by deflection angle method.
4	To traverse an area by continuous azimuth method
5	To determine a height of an electric pole / building tower by measuring vertical angle from a single station
6	To determine a constant of given a tacheometer
7	To determine a distance from the instrument's stations to the given stations
8	To traverse an area by measuring horizontal angles and staff intercept
9	To range a curve by chord of offset method
10	To range a curve by chord & angle method
11	To measure a given base line & apply necessary correction on it
12	To prolong a given base line up to a given length
13	To conduct a triangulation survey in a given area
14	To conduct correlation survey by exact alignment method
15	To conduct correlation survey by direct method of traversing
16	To conduct correlation survey by approximate alignment method
17	Demonstration of Total station.
18	Demonstration of EDM.