



BIKANER TECHNICAL UNIVERSITY, BIKANER

बीकानेर तकनीकी विश्वविद्यालय, बीकानेर

OFFICE OF THE DEAN ACADEMICS



SYLLABUS OF UNDERGRADUATE DEGREE COURSE

Mining Engineering



Effective for the students admitted in year 2021-22 and onwards.



B.Tech.: Mining Engineering
2nd Year - III Semester

THEORY											
SN	Category	Course Code	Course Title	Hours			Marks				Cr
				L	T	P	Exm Hrs	IA	ETE	Total	
1	UCB	3MI1 – 01	Numerical Techniques	3	0	0	3	30	70	100	3
2	DC	3MI4 – 02	Introduction to Basic Mining Engineering	3	0	0	3	30	70	100	3
3		3MI4 – 03	Basic and Applied Mine Geology	3	0	0	3	30	70	100	3
4		3MI4 – 04	Basic Mine Surveying	3	0	0	3	30	70	100	3
5		3MI4 – 05	Fundamentals of Rock Mechanics	3	0	0	3	30	70	100	3
6		3MI4 – 06	Underground Mining Machinery	3	0	0	3	30	70	100	3
			Sub Total	18	0	0		180	420	600	18
PRACTICAL & SESSIONAL											
7	DC	3MI4 – 20	Introduction to Basic Mining Engineering Lab	0	0	2	-	60	40	100	1
8		3MI4 – 21	Basic and Applied Mine Geology Lab	0	0	2	-	60	40	100	1
9		3MI4 – 22	Basic Mine Surveying Lab	0	0	2	-	60	40	100	1
10		3MI4 – 23	Fundamentals of Rock Mechanics Lab	0	0	2	-	60	40	100	1
11		3MI4 – 24	Underground Mining Machinery Lab	0	0	2	-	60	40	100	1
12	UI	3MI7 – 30	Industrial Training	0	0	2	-	60	40	100	1
13	UGE/CA	3MI8 – 00									1
			Sub- Total	0	0	12		360	240	600	7
			TOTAL OF III SEMESTER	18	0	12		540	660	1200	25

L: Lecture, **T:** Tutorial, **P:** Practical, **Cr:** Credits **ETE:** End Term Exam, **IA:** Internal Assessment



B.Tech. : Mining Engineering
2nd Year - IV Semester

THEORY											
SN	Category	Course Code	Course Title	Hours			Marks				Cr
				L	T	P	Exm Hrs	IA	ETE	Total	
1	UCB	4MI1 – 01	Probability and Statistics for Mining	3	0	0	3	30	70	100	3
2	DC	4MI4 – 02	Rock Fragmentation Engineering	3	0	0	3	30	70	100	3
3		4MI4 – 03	Applied Mine Surveying	3	0	0	3	30	70	100	3
4		4MI4 – 04	Surface Mine Mechanization	3	0	0	3	30	70	100	3
5		4MI4 – 05	Safety, and Health Environment in Mining	3	0	0	3	30	70	100	3
6		4MI4 – 06	Applied Rock Mechanics	3	0	0	3	30	70	100	3
			Sub Total	18	0	0		180	420	600	18
PRACTICAL & SESSIONAL											
7	DC	4MI4 – 20	Rock Fragmentation Engineering Lab	0	0	2	-	60	40	100	1
8		4MI4 – 21	Applied Mine Surveying Lab	0	0	2	-	60	40	100	1
9		4MI4 – 22	Surface Mine Mechanization Lab	0	0	2	-	60	40	100	1
10		4MI4 – 23	Safety, Health and Environment in Mining Lab	0	0	2	-	60	40	100	1
11		4MI4 – 24	Applied Rock Mechanics Lab	0	0	2	-	60	40	100	1
12		4MI4 – 25	Introductory Computing Lab	0	0	2	-	60	40	100	1
13	UGE/CA	4MI8 – 00									1
			Sub- Total	0	0	12		360	240	600	7
			TOTAL OF IV SEMESTER	18	0	12		540	660	1200	25

L: Lecture, T: Tutorial, P: Practical, Cr: Credits, ETE: End Term Exam, IA: Internal Assessment



3MI4-01: Numerical Techniques

Credit: 3Max.

3L+0T+0P

Marks: 100(IA: 30, ETE: 70)

End Term Exam: 3 Hours

Course Objectives

- To provide essential knowledge of Errors in Numerical Methods, Solution of equations in one variable and Numerical solution of system of equations
- Analyze to solve the problem of Operators and Difference Equations, Newton's forward interpolation formula, Gauss Forward central Difference Formula, etc.

Course Outcomes

- Able to solve numerical, Bisection, Iteration, Regula-Falsi, Convergence of Regula-Falsi, Graffe's Root-Squaring, etc method of problem.
- Know about numerical solution of system of equations & Operators and Difference Equations.
- Able to solve Newton's forward & backward interpolation formula and Gauss' Forward central Difference Formula; Gauss' Backward central Difference Formula; Computer Programs for the above formulas.
- Know the various method of Numerical Methods of Solution of O.D and Numerical integration

SN	Contents	Hours
1	Errors in Numerical Methods: Approximate numbers and Significant figures; Rounding-off numbers; Errors: Absolute, Relative and Percentage; Error in Arithmetical operations; A General Error Formula; Errors in Numerical Computations; Inverse Problems.	3
2	Solution of equations in one variable: Bisection method; Iteration method; Regula-Falsi method; Convergence of Regula-Falsi method; Secant method; Newton-Raphson method; Generalised Method for multiple roots; Rate of Convergence of Newton's square root formula; Newton's Inverse formula.	6
3	Numerical solution of system of equations: Gauss elimination method; Gauss-Jordan method; Jacobi's iteration method; Gauss Sidel method; Ill conditioned problems.	5
4	Operators and Difference Equations: Forward difference operator, Backward difference operator, Shift operator, Average operator, Central difference operator and their relations; Factorial Notation; Synthetic division; Missing Term Technique.	5
5	Interpolation: Newton's forward interpolation formula; Newton's backward interpolation formula; Stirling's Formula; Bessel formula; Lagrange's interpolation formula; Divided differences; Newton's divided difference formula; Numerical differentiation and applications; Central Difference Interpolation Formulae; Gauss' Forward central Difference Formula; Gauss' Backward central Difference Formula.	9
6	Numerical integration: A general quadrature formula for equidistant nodes; Trapezoidal rule; Simpson's one-third rule, Simpson's three-eighth rule; Weddle's rule;	4
7	Numerical Methods of Solution of O.D.E: Picard's Method of Successive Approximations; Picard's Method for Simultaneous First Order Differential Equations; Euler's Method;; Modified Euler's Method; Runge-Kutta method.	8
Total		40

TEXT BOOKS

- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation.

REFERENCE BOOKS

- Kendall Atkinson, An Introduction to Numerical Analysis.

**3MI4-02: Introduction to Basic Mining Engineering****Credit: 3****3L+0T+0P****Course Objectives**

- To aware of unit operations in mining, different mining methods, environmental impacts of mining aspects.
- To provide essential knowledge in Drilling & Blasting and different types of explosives and their properties in Mining.

Course Outcomes

- To Understanding of different unit operations in mining.
- To Understanding of environmental impacts of mining and their remediation.
- To identifying the different drilling machines, their mechanism and applications.
- To Understanding of different mining methods used for metallic and non-metallic mineral extraction.

SN	Contents	Hours
1	Mineral resources of Rajasthan, India and World; Mining of important economic minerals in India; Various terms used in mining; Stages in the life of the mine, Introduction to unit operations, Economical, Social, Environmental and Health impacts of Mining.	6
2	Prospecting: Reconnaissance; principles and methods of prospecting - pit, shaft, trench and boreholes; Principle, method, Work schedule and application of Geologic, Geophysical, Geochemical, Electrical, Electromagnetic, Gravity methods of prospecting, Sampling techniques; planning a prospecting programme Application of Remote Sensing and GIS in mineral prospecting.	8
3	Exploration: Boring, Principles of boring, Selection of sites for boreholes; Surface layout of boring; Details of equipment, Core recovery, Borehole logging; Maintenance of records; Deflection of boreholes; Difficulties in boring; Fishing tools and their uses; Methods of exploratory drilling for oil; Interpretation of borehole data.	7
4	Drilling and Blasting: Introduction to drilling and blasting, various methods of rock drilling for surface and underground applications; Types, classification and comparative properties of explosives; Development of explosives; SMS, emulsion, Blasting devices; Electric, non –electric and electronic blasting initiations; Priming; solid blasting, Safety considerations.	8
5	Pre mining, mining and post-mining: ancillary mining operation, Types and construction of entries to mineral deposits – Shaft, Incline, Adit – applicable conditions-limitations. Basic concepts of surface and underground mining, Comparison of underground and surface mining.	7
Total		40

TEXT BOOKS

1. D.J.Deshmukh, Elements of Mining Technology-Vol I, Central Techno Publications, Nagpur, 7th Ed, 2001.
2. H.L.Hartman, Introductory Mining Engineering, John Wiley, New York, 1987
3. G. K. Pradhan, Explosive and Blasting Technology, Mintech Publications, Bhubaneshwar

REFERENCE BOOKS

1. Shevyakov, Mining of Mineral Deposits, Foreign Language Publishing House, Moscow
2. S.Krishnaswamy, India's Mineral Resources, Oxford & IBH Pub. Co., New Delhi.
3. Gary B. Hemphill, Blasting operations, McGraw Hill, 1981
4. G.B.Clark, Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987

**3MI4-03: Basic and Applied Mine Geology****Credit: 3**
3L+0T+0P**Max. Marks: 100(IA: 30, ETE: 70)**
End Term Exam: 3 Hours**Course Objectives**

- To understand the geological structures developed in rocks by the action of force, action on them formation and classification of minerals.
- To understand the various processes of mineral deposit formation, occurrence, origin, economic importance, distribution of selected ore minerals.
- Understand physical and Exploration geology and geological mapping.

Course Outcomes

- Briefly about the origin and occurrence of different minerals and emphasizes their distribution in India.
- know the different processes which are responsible for the formation of different economic minerals.
- To know difference types of minerals, classification and properties of rocks.
- To get knowledge in finding ore deposits using geological, geophysical and geochemical knowledge

SN	Contents	Hours
1	Introduction and importance of geology in Mining: Evolution , age , origin and interior of the earth; Physio-graphic features of India ; Geological Time Scale; Exogeneous and endogeneous processes; Metallogenesis.	8
2	Physical geology: Geological processes- weathering, erosion, transportation and deposition; Geological work done by wind, river, lake, glacier, underground water and sea;	8
3	Mineralogy: Definition of mineral, identification by physical, chemical and optical properties; Polymorphism and isomorphism; Crystallography and its definition; Crystal systems in brief; Classification of rock forming minerals; Description of mineral families. i.e. feldspar group, mica group, pyroxene group, amphibole group.	8
4	Petrology: Definition of rock, formation, crystallization, texture, structure and classification of igneous rocks; Definition of sedimentary rocks, formation, texture, structure and classification; Definition of metamorphic rock, metamorphism, agents responsible for metamorphism, texture, structure and classification.	7
5	Economic Geology: Structural Geology; Dip and Strike, study of folds, faults, Joints, unconformities, Economic Geology; Magmatic, Hydrothermal, Sedimentary, Metamorphic deposits, oxidation and supergene enrichment, study of Gold, Iron, copper, lead, Zinc Chromite, manganese, bauxite, mica, asbestos, magnetite, borytes deposits.	5
6	Application of Geology in Mining Exploration Geology; Principles, Stages of mineral exploration, Geological, Geophysical, geochemical and remote sensing methods of exploration. Applied Geology; Sampling, guides for locating ore deposits, geological mapping, Hydrogeology	4
Total		40

TEXT BOOKS

1. Parbin Singh, Engineering and General Geology, Katson Pub. Delhi, 6th Edition 2001
2. Mukerjee.P.K. A text book of Geology, World Press Pvt. Ltd. 11th Edition, 1990
3. K.M. Gurappa, Structural geology Manual
4. B.S. SathyaNarayanawamy Engineering Geology Laboratory Manual, Eurasia pub.
5. ArogyaSwamy, Courses in Mining Geology, Oxford & IBH, 1988

REFERENCE BOOKS

1. Bateman A.M., Economic mineral deposits, John Wiley & Sons
2. Billings, Structural Geology



3MI4-04: Basic Mine Surveying

Credit: 3
3L+0T+0P

Max. Marks: 150(IA: 30, ETE: 70)
End Term Exam: 3 Hours

Course Objectives

- To know and handling various surveying instruments.
- To know about the various surveying methods like Theodolite, tacheometric surveying, Levelling, triangulation surveying etc.

Course Outcomes

- Knowledge of using various types of surveying instruments.
- Knowledge of various surveying methods
- To handling of Total Station and Digital theodolites.
- Basic concept of triangulation surveying.

SN	Contents	Hours
1	Introduction: Importance of surveying in mining, application fields, scope, chronological evolution of survey in mining industry. Introduction to chain survey and miner's dial, Compass Surveying; offsetting and related angular and linear measurement.	6
2	Theodolite: Various types, Scope, temporary and permanent adjustments, measurement of horizontal and vertical angles. Traversing: Theodolite traversing, traverse plotting, Closing error and its adjustment. Omitted measurements and their calculations	9
3	Levelling: Scope and purpose of Levelling; Different levelling instruments; Height of instrument Method and Rise and fall method; Different methods of levellings Computation of areas and volumes: Area and volume of regular figure, methods of area calculations, methods of boundary area calculation, Planimeter.	10
4	Contouring: Definitions, characteristics of contours, methods of contouring by level, tacheometric contouring, Interpolation of contours.	5
5	Tacheometric Surveying: Principle, additive and multiplying constants, determination of constants, Reduction of data by use of tacheometric table. Type of tacheometry. General procedure for field work.	7
6	Total station : principle, working, construction and its application in mining (Basics)	3
Total		40

TEXT BOOKS:

1. Surveying (Vol – 1, 2 & 3), by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain -Laxmi Publications (P) Ltd., New Delhi
2. Duggal S K, "Surveying (Vol – 1 & 2), Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2004.

REFERENCE BOOKS

1. R. Subramanian, Surveying and levelling, Oxford university press, New Delhi
2. Dr.B.C.Punmia, Surveying Vol. I & II, Pub: Laxmi Publication New-Delhi 2 T.P. Kanetkar, Surveying & Levelling, Vol I & II, Geeta book store Dhanbad



3MI4-05: Fundamentals of Rock Mechanics

Credit: 3

3L+0T+0P

Course Objectives

- To Understand the Stresses and strains and their inter relationship, Physico mechanical and in-situ properties of Rocks & Soil.
- Be able to understand the Elastic constants, Rock mass classification and Rock fracture mechanics.

Course outcomes

- Have knowledge of stress, strain and their relationship.
- Know the various properties of rocks, their determination and application.
- Know the different rock mass classifications, applications and limitations.
- Knowledge of rock fracture mechanics.

Max. Marks: 100(IA: 30, ETE: 70)

End Term Exam: 3 Hours

SN	Contents	Hours
1	Application of Rock Mechanics. Stress and Strain in Rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rock under static and dynamic loading.	8
2	Physico-mechanical Properties of Rock: Determination of physical properties, strengths, strength indices and static elastic constants; parameters influencing strength, abrasivity and of its determination. Specific gravity, hardness, porosity moisture content, permeability, swell index, slake durability, thermal conductivity.	7
3	Dynamic Properties of Rock and Rockmass Time Dependent Properties of Rock: Creep deformation and strength behaviour; creep test and archeological models.	8
4	Behaviour of Rockmass: Rockmass structure, classification in-situ elastic properties and strength determination. Failure Criteria for Rock and Rockmass: Mechanics of rock failure; Coulomb, Mohr and Griffith criteria; empirical criteria. Pre-mining State of Stress: Sources, methods of determination including overcoring and hydro-fracturing methods.	8
5	Physico-mechanical Properties of Soil: Physical properties including consistency and gradation: classification of engineering soils; engineering properties of soils compressibility, consolidation, compaction and strength. Ground Water: Influence of water on rock and soil behaviour; permeability of rocks; measurement of permeability; ground water flow in rockmass; measurement of water pressure. Use of computers in rock mechanics problems.	9
Total		40

TEXT BOOKS:

- Obert, L and Duvall, W.I. Rock Mechanics and design of Structure in Rock John Wiley and Sons Inc., New York 1967.
- Vutukuri, V.S. and Lama, R.D. Handbook on Mechanical Properties of Rocks, Vol. I, II, III, and IV, Transtech Publication, Berlin, 1974/78
- Jumikis, A.R. Introduction to Rock Mechanics, Oxford & IBH Publishing Company, New Delhi.

REFERENCE BOOKS

- Peng, S.S. Ground Control, Wiley Publications, New York, 1987
- Brady, B.H.G. and Brown, S.T. Rock Mechanics for Underground Mining, Chapman and Hall, 1993
- Goodman R.E. Introduction to Rock Mechanics, John Wiley & Sons, 1989

**3MI4-06: Underground Mining Machinery****Credit: 3****3L+0T+0P****Course Objectives**

- To aware of different types of mining equipment, Signaling and Winding used in underground and surface mines.

Course Outcomes

- To understand the various types of transportation equipment used in underground.
- To understand the motive power used in mines including compressed air power.
- To know the Construction, maintenance, capping and splicing of wire ropes.
- Understanding drum and winding systems, their suspension gear and braking arrangements.
- Types of drainage and pumps used in mines.

Max. Marks: 100(IA: 30, ETE: 70)**End Term Exam: 3 Hours**

SN	Contents	Hours
1	Winding: Head gear, Pulley, Shaft fittings and their design. Different types of winding, mechanical and electrical braking. Ward Leonard control, automatic winding. Winding drums: types their construction and duty cycles, detaching hooks, cages, skips and suspension gear, rigid and rope guides. Methods of counter balancing loads, Multi rope winding, winding from different horizons. Design calculation for different types of winding system. Safety devices.	8
2	Signaling: Safety regulations different signaling system in mines. Compressed Air: Pipe lines and distribution of compressed air, calculations of main parameters. Comparison of compressed air with other forms of power.	7
3	Wire Ropes: Wire ropes used in mines; Different types and their construction, installation and tests; Rope splicing and change of ropes; Rope capel and process of capping. Haulage: Rope haulage-Different types, constructions, installation, maintenance and design calculation; Haulage track: its laying and maintenance, gauge-selection, Safety devices	8
4	Cutting cum Loading Machines: Continuous Miner, Road Header, Shearer and Plough & their construction, operation and maintenance. Loading and Transport: SDL, LHD, LPDT, Gathering Arm Loader, shuttle car, mine tubs & mine locomotives: Different types, their construction, operation and maintenance.	8
5	Conveyor: Different types- chain, belt conveyors and AFC & their construction, installation maintenance and design calculations; Mineral Handling: Layouts of pit-top and pit-bottom, creepers, tipplers; details of banking; mineral handling and screening equipment, Railway siding. Use of Computers in designing of various machinery systems.	9
Total		40

TEXT BOOKS

- S. Ghatak, Mine Pumps Haulage and Winding, Lovely Prakashan Pub
- C. F. Statham Coal Mining Practice-Vol II, Caxton Eastern, Calcutta
- R.D.Singh, Principles and practices of modern coal mining, New Age International

REFERENCE BOOKS

- R.T. Deshmukh, Winning and Working Coal in India, ISMAG Co op. Store Ltd., Dhanbad
- Thomas Bryson, Mine Machinery, Pitman
- Madisetti A Ramlu, Mine Hoisting, Taylor & Francis Pub.
- Ernest E. Wahlstrom, Tunneling in Rock, Elsevier Scientific Publishing Company.
- Lewis and Clark, Element of Mining, John Wiley & Sons, New York



3MI4-20 Introduction to Basic Mining Engineering Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- To aware the mining terminologies, different mining inventory in Rajasthan as well as India.
- Knowledge in Drilling, Blasting and their properties in Mining.

Course Outcomes

- To understanding the mining terminologies.
- To aware the mineral inventory of Rajasthan and India
- Application of Geologic, Geophysical, Geochemical, Electrical, Electromagnetic, Gravity methods of prospecting
- To understanding the different mode of entries and classification of various drilling methods

Contents of the Subject
<ol style="list-style-type: none">1. Definitions of the various Mining terminologies.2. Mineral inventory of Rajasthan3. Mineral inventory of India.4. Application of Geologic, Geophysical, Geochemical, Electrical, Electromagnetic, Gravity methods of prospecting,5. Different mode of entries.6. Classification of various drilling methods.7. Explosive properties.



3MI4-21 Basic and Applied Mine Geology Lab

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)

Course Objectives

- Understand the basics of mineralogy and petrology and learn identification of some minerals and rocks.

Course Outcomes

- To introduce fundamental concepts, ideas and materials in geology.
- To Aware of Geomorphic models, Geological Time-Scale, Succession of India & Rajasthan availability of minerals.
- Experimental Exercises on structural maps of geological sites and interpretation of geological conditions.
- Understanding to determination of thickness of rock layer/beds.

Contents of the Subject

1. Minerals under handspecimen.
2. Rocks under handspecimen.
3. Geomorphic models.
4. Geological Time-Scale.
5. Geological succession of India and available minerals.
6. Geological succession of Rajasthan and available minerals.
7. Geologic maps and sections.
8. Structural Geology: Exercises on Structural maps of geological sites and interpretation of geological conditions.
9. Dip & strike, determination of thickness of rock layers/beds



3MI4-22: Basic Mine Surveying Lab

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)

Course Objectives

- Knowledge of various surveying instruments and surveying methods in plane surveying.

Course Outcomes

- To know the application of each experiment and be able to apply mine surveying method using suitable apparatus/equipment.

Contents of the Subject

1. Location of Buildings/Structures by offset survey.
2. Closed traversing by compass survey using Prismatic compass.
3. Closed traversing by compass survey using Surveyors compass.
4. Measurement of horizontal angles by method of repetition and reiteration using theodolite.
5. Measurement of vertical angles by theodolite.
6. Closed traversing and balancing using theodolite.
7. Measurements of RLs of different stations with Height of Instruments method using dumpy level.
8. Measurements of RLs of different stations with Rise and fall method using Auto level.
9. Determination of horizontal and vertical distances by Tachometric surveying
When staff held vertical to line of sight.
10. Determination of horizontal and vertical distances by Tachometric surveying
When staff held normal to line of sight.
11. Plotting of contours by Method of squares.
12. Calculation of Area and Volume of regular/irregular figures.



3MI4-23: Fundamentals of Rock Mechanics Lab

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)

Course Objectives

- To determination and knowledge of various rock properties in the laboratory

Course Outcomes

- Understanding the concept of rock mechanics laboratory testing of rocks
- Knowledge of rock mechanics testing apparatus/equipment used
- Practical usage of rock mechanics testing apparatus/equipment.
- Practical experience on Sample preparation for different tests in laboratory.
- Practical experience on different tests (Uniaxial and Tri-axial compressive strength, Tensile strength, Shear strength, Protodyakonov's strength index, Point load strength and Slake durability index) of given rock sample.

Contents of the Subject

1. Preparation of rock specimens for laboratory tests.
2. Determination of porosity and density
3. Determination of uni-axial compressive strength of rocks.
4. Determination of point load strength index.
5. Determination of tensile strength of rock by Brazillian test.
6. Determination of Protodyakanov index of the given rock specimen.
7. Determination of slake durability index of rocks.
8. Determination of shear strength & punch shear strength.
9. Schmidt hammer test.
10. Determination of Tri-axial compressive strength of rocks.



3MI4-24: Underground Mining Machinery Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- To determination and knowledge of different types of ropes, haulage system, loco garage, conveyor systems in the laboratory.
- Knowledge of all types of underground mining machinery

Course Outcomes

- To understand the rope mechanism, different types, design and application of rope capels.
- To perform loading, unloading, transfer, turning and terminal station of aerial rope.
- To understand the conveyor system and belt & loop arrangements.
- To aware about of Battery charging for underground mining.

Contents of the Subject

1. Wire ropes construction and determination of space factor
2. Rope splicing
3. Different types of rope capels and method of recapping
4. Design and application of rope capels
5. Various stations in aerial rope way e.g. Loading, Unloading, Transfer, Turning, Terminal stations
6. Laying of tracks and different crossings
7. Safety devices used on haulage system
8. Battery charging station
9. Loco garage
10. Conveyor systems
11. High angled conveyor
12. Belt tensioning arrangement and Loop take up arrangements
13. Sequentially controlled belt conveyor system



3MI4-30: Industrial Training

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)

**4MI4-01: Probability and Statistics for Mining****Credit: 3**
3L+0T+0P**Max. Marks: 100(IA: 30, ETE: 70)**
End Term Exam: 3 Hours**Course Objectives**

- Introduce the basic concepts of one dimensional and two dimensional Random Variables
- Provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- Use the concepts of multivariate normal distribution and principle components analysis.
- Learn different testing Hypothesis.
- Analyse the Design of experiments and Time series.

Course Outcomes

- To acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems, which useful in solving engineering problems.
- To evaluate the strength of evidence from the sample and provides a framework for making determinations related to the population.
- To understand the notation of the population distribution and Sampling distributions.
- To develop efficient algorithms for solving dynamic programming problems, to acquire skills in handling situation involving random variable.

SN	Contents	Hours
1	Probability and random variable: Probability – Random variables – Moments – Moment generating function – Standard distributions – Functions of random variables – Two-dimensional R.Vs – Correlation and Regression.	8
2	Estimation theory: Principle of least squares – Regression – Multiple and Partial correlations – Estimation of Parameters – Maximum likelihood estimates – Method of moments.	8
3	Testing of hypothesis: Sampling distributions – Test based on Normal, t-distribution, chi-square, and F-distributions – Analysis of variance – One-way and two way classifications	8
4	Design of experiments: Completely Randomized Design – Randomized Block Design – Latin Square Design – 2 Factorial Designs.	8
5	Time series: Characteristics and Representation – Moving averages – Exponential smoothing – Auto Regressive Processes.	8
Total		40

REFERENCES:

1. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", 5th Edition, Prentice Hall, 1994.
2. Jay, L.Devore, "Probability and Statistics for Engineering and Sciences", Brooks Cole Publishing Company, Monterey, California, 1982.
3. Montgomery D.C and Johnson, L.A, "Forecasting and Time series", McGraw Hill.
4. Anderson, O.D, "Time series Analysis: Theory and Practice", I.North-Holland, Amsterdam, 1982.



5. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 1999.

4MI4-02: Rock Fragmentation Engineering

Credit: 3

3L+0T+0P

Course Objectives

- Concepts and theories of rock fragmentation by Blasting.
- To understanding fragmentation measurement and alternative methods.
- Latest developments in surface and under water blasting techniques.
- To provide knowledge of Blasting damages ground vibrations, air blasts and fly rocks.
- Controlled blasting and economic evaluation of blasting.

Course Outcomes

- Design of blasts and selecting suitable explosives.
- Understanding the different rock breakage mechanisms.
- Predicting rock fragmentation using different mathematical models and also analysing the fragmentation using different assessing methods.
- Latest developments in underground & underwater blasting and surface blasting.

Max. Marks: 100(IA: 30, ETE: 70)

End Term Exam: 3 Hours

SN	Contents	Hours
1	Fragmentation by Blasting Mechanism of rock fragmentation by blasting. Explosives – trends and selection. Principles and application of explosives. Casting of rocks. Controlled blasting methods. Design of multi-row blast rounds. Design of blast rounds for tunnels and drifts.	8
2	Fragmentation Measurement Methods Application of high speed videography and image analysis techniques for measurement of rock fragmentation by blasting, blast surveys, audits and documentation for monitoring of fragmentation. Computational methods.	10
3	Blasting Nuisances Blasting damages ground vibrations, air blasts and fly rocks. Mitigation of damages due to blasting	6
4	Alternative Methods for Rock Fragmentation Rock breakage and fragmentation by Physico-mechanical, hydraulic, plasma, nuclear and other methods. Physical, chemical and nuclear methods. Mechanism of fragmentation by water jets, mechanical, and ploughs, roller and disc cutters.	10
5	Special Blasting Techniques Underwater blasting, demolition blasting smooth blasting and hot hole blasting.	6
Total		40

TEXTBOOKS

1. Pradhan G.K., Ghose A.K. "Drilling & Blasting" Minetech.
2. Sastry V.R, Advance in Drilling and Blasting
3. Bhandari S., Engineering Rock Blasting Operations, A.A. Balkema/Rotterdam.

**4. 4MI4-03: Applied Mine Surveying****Credit: 3**
3L+0T+0P**Max. Marks: 100(IA: 30, ETE: 70)**
End Term Exam: 3 Hours**Course Objectives**

- Knowledge of various surveying instruments.
- To provide essential knowledge of various surveying methods like tacheometric surveying, curve ranging, triangulation, correlation survey etc.,
- To aware the modern instruments in surveying.

Course outcomes:

- To able to using various surveying instruments.
- To understanding various surveying methods.
- To Handling of Total Station and Digital theodolites

S. No.	Contents	Hours
1	Triangulation Survey: Basic principle and methods of triangulation survey, Signals, Towers and satellite station.	6
2	Curve ranging: Definitions in curve setting; Different types of curves; Purpose; Methods of curve setting: Linear methods and Instrumental methods; Super elevation. Laying of curves in underground: Purpose, Possible obstructions/difficulties in setting curve. Setting curve underground.	7
3	Fault and dip problems: fault calculation, cross measure drift calculation, Bore hole calculation, Determination of true thickness from core. Subsidence survey.	6
4	Correlation survey: Purpose, different methods of correlation survey: Coplanation, Weissbatch triangle and Weiss quadrilateral method	6
5	Theory of errors: Classification & types of error, precaution against error, accidental error and the law of probability, principles of least square, true error, apparent error, average error, mean square and probable error, weight of a error and law of weight, limiting error, acceptable limits of error (by DGMS)	6
6	Stope Surveying: Purpose, methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. Tape triangulation. Traversing. Radiation. Calculating mineral output, percentage of extraction calculation	6
7	Aerial photogrammetry; Introduction of field astronomy (basics): definitions and determination of true north	3
Total		40

TEXT BOOKS

1. William Wesely Staley, Introduction to Mine surveying, Stanford University Press
2. B.C. Punmia, Surveying Vol.II,III, Lakshmi Publications, 1994.
3. T.P.Kanetker and S.V. Kulkarni, Surveying and leveling Vol I and II, Vidyapith Grihan Prakashan, Pune.

REFERENCE BOOKS

1. Ghatak, Mine Surveying Vol. I, II, III, 5th edition, Coal Field Publishers, 1996.
2. V. Borsheh and Komponiets, Mine Surveying, Mir-Publishers, 1989.
3. Ghosh, Mine Surveying, Lovely Prakashan Pub., Pune
4. Raymond E.Davis, Francis S. Foote, J.M.Anderson and E.M.Mikhail, Surveying Theory and Practice, Land Surveyors Pub., 1997



4MI4-04: Surface Mine Mechanization

Credit: 3

3L+0T+0P

Course Objectives

- To impart the knowledge and Overview of Surface Mine Mechanization.
- Drilling and blasting practices in surface mines.
- To know various excavation, loading and transporting machineries.
- To analysis the Equipment planning for entire mine production and Techno-economic indices of mechanized systems.

Course outcomes

- To aware the challenges and possibilities for mechanization of surface mines.
- To know the selection of equipments for various mining operations.
- To understanding the material handling systems of transportation in surface mines.
- To understand and analysis the constructional and operational features of various heavy earth moving machineries.
- Knowledge of machine learning and big data analytics in mine mechanization.

SN	Contents	Hours
1	Overview of Surface Mine Mechanization Need for mechanization of surface mines. Social, organizational aspects and desired level of mechanization in India and around the globe. Challenges and possibilities.	6
2	Drilling in Surface Mines: Classification, Principles, Mechanism, Applications, merits and limitations of different drilling methods, Percussive, rotory and rotory percussive drilling	8
3	Excavation in Surface mines Bull dozer, Grader, Water Sprinkler, Spreader Front End Loader, Back Hoe, Rope and Hydraulic Shovel, Dragline, BWE, Surface Miner	8
4	Transportation in Surface Mines Material Handling Systems: Rear Dump Trucks, Conveyors and Rail transport system, In-pit crushing, Rail High/Steep Angle conveyor system, Arial Ropeway, Bunkers, chutes. Fleet Management System	8
5	Maintenance Planning Breakdown maintenance; Role of condition monitoring: Planned, preventive and predictive maintenance.	5
6	Other Aspects of Mechanization Techno-economic indices of mechanized systems. Equipment availability, utilization and reliability, Automation and Productivity monitoring system, Basics of applications of AI, Machine learning and Big Data Analytics in mine mechanization	5
Total		40

TEXT BOOKS

1. D. J. Deshmukh, Elements of Mining Technology in 3 volumes, Denett & Co., 2011
2. S. F. Walker, Mining & Mining Machinery, Nabu Press, 2010
3. G. B. Mishra, Surface mining, Dhanbad Pub., 1978

REFERENCE BOOKS

1. S. Ghatak, Mine Pumps Haulage and Winding, Lovely Prakashan Pub
2. Amitosh Dey, Heavy Earth Moving Machinery, Lovely Prakashan Pub
3. Bill Robertson, Caterpillar Earthmovers, Iconografix USA July 2004.
4. Eric C Orleman, Heavy Earthmoving Equipments, Motorbooks International, October 1995.

**4MI4-05: Safety, Health and Environment in Mining****Credit: 3**
3L+0T+0P**Max. Marks: 100(IA: 30, ETE: 70)**
End Term Exam: 3 Hours**Course Objectives**

- To know about different risk analysis procedure for assessment of risk at workplaces due to presence of different type of occupational hazards.
- To provides knowledge on principles of noise, water and air pollution control for underground and opencast machinery working in mines.

Course outcomes

- Understanding various types of occupational hazards occurring in mines.
- Understanding ways to analyze and control the occupational hazards: engineering approach and systems approach.
- To aware of safety planning, analysis and management.
- Analyzing economics of safety measures and their cost effectiveness
- To know ill effects of noise and engineering control of noise for machinery working in mines
- To know about the Land degradation and air & water pollution and remediation

SN	Contents	Hours
1	Accidents and Safety in Mines: Mine accidents, types of accidents, roof fall accidents. Planning for safety, ZAP and MAP; Safety analysis, Safety prevention and precautions. Information system and safety audits.	6
2	Occupational Health and Hygiene: Occupational health, hygiene in Mining Industry; Monitoring and Control measures; occupational diseases: symptoms, causes, preventive and curative measures; Long term health issues and insurance for mine worker.	7
3	Environmental issues in mining industry Impact on Socio-Economic-Cultural changes: Direct and indirect ; demography, housing, local services, societal, people, employment etc.; Introduction to Social Cost Benefit Analysis (SCBA)	6
4.	Land degradation and remediation: Visual impacts; degradation of soil quality landscape analysis; land use pattern; landscape planning; Impacts on flora and fauna.	5
5.	Water Pollution and remediation: Natural drainage pattern, water table, Impact on surface water and on sub-surface waters, Acid Mine Drainage; AMD Generating Minerals, AMD Formation, its impact on the environment, problems in India.	6
6.	Air Pollution and remediation: Gaseous and particulate air pollution sources, monitoring and control, Airborne Repairable Dust: Generation, dispersion, measurement and control.	5
7.	Noise and Blasting: Impact on human health, noise level, noise abatement strategies, standards; Environment aspects of ground and air Vibrations, fly rock, Dust.	5
Total		40

TEXT BOOKS:

1. Ridley,J & C Channing: Safety at work: Butter worth- Heinemaan. Oxford,2001.
2. Rodgers. W.P: Introduction of system safety Engineering: John Wiley & Sons Inc.,NewYork, 1971.



3. Greem A R; Safety in Mines Reserch : A,R. Balkena, Rotterdam,1985.
4. K.N. Duggal, Elements of Environmental Engineering, S.Chand & Company Ltd. New Delhi, 2012.
5. Howard S.Peavy , Donald R. Rowe , Environmental Engineering.
6. George Tchobanoglus- Mc-Graw-Hill Book Company, New Delhi, 1985
7. Wastewater Treatment for pollution control and Reuse, by soli.J Areivala, sham R Asolekar, Mc-GrawHill, New Delhi; 3rd Edition
8. Industrial water & wastewater management by KVSG MuraliKrishna

REFERENCE BOOK:

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering, by Garg, S.K.,: Khanna publishers
2. Sewage treatment and disposal by Dr.P.N.Modi & Sethi.
3. Environmental Engineering, by Ruth F. Weiner and Robin Matthews- 4th Edition Elsevier, 2003
4. Environmental Engineering by D. Srinivasan, PHI Learning private Limited , New Delhi,2011.

**4MI4-06: Applied Rock Mechanics****Credit: 3****3L+0T+0P****Max. Marks: 100(IA: 30, ETE: 70)****End Term Exam: 3 Hours****Course Objectives**

- To make aware In-situ stresses in the earth's crust and Stress around Mine Openings.
- To know about scope and types of measurements by various field instruments and instrumentation techniques.
- To provide essential knowledge on design of pillars, different types of supports, subsidence- prediction, prevention, rock burst and coal bumps.

Course outcomes

- Know the importance of stress on underground openings both in single and multiple openings and also in different shaped openings.
- To know the design of pillars, open pit slopes and waste dumps
- To understand the different types of supports used in mines, different criteria to design and select the suitable supports.
- Know the concept, prediction, prevention and determination of subsidence
- Causes and effects of bumps and rock bursts
- Knowledge of measurements instruments and instrumentation techniques

SN	Contents	Hours
1	In-situ Stresses In-situ stresses in the earth's crust. Methods of in-situ stress determination.	7
2	Stress Around Mine Openings Distribution of stresses around mine openings of various shapes. Design of Mine Openings and Pillars	7
3	Design of Supports Rock bolting, cable bolting, roof stitching, shotcreting, support for bord and pillar and longwall workings. Goaf Support Mechanics of caving and filling.	8
4	Subsidence Mechanism, prediction and control. Design of shaft pillar. Rock Bursts and Bumps Mechanism, prediction and control.	8
5	Field Instrumentation: Scope and types of measurements by various field instruments and instrumentation techniques: Stress, strain, deformation and convergence, subsidence, strata movement, rock behaviors in stope. Slope design and monitoring, slope stability radar and other contemporary techniques, other excavation design and monitoring	10
Total		40



TEXT BOOKS

1. L. Obert and W. I. Duvall, Rock Mechanics and the Design of Structures in Rocks, John Wiley and Sons, 1966.
2. S. Peng, Coal Mine Ground Control, John Wiley and Sons, Inc. 1978.
3. Jager & Cook, Fundamentals of Rock Mechanics, Methuen and co. London, 1969.

REFERENCE BOOKS

1. M. L. Jeremic, Ground Mechanics in Hard Rock Mining - Oxford & IBH Publishing Co. New Delhi, 1987.
2. C. Biron & E. Arioglu, Design of Supports in Mines -, John Wiley & Sons, N Y, 1983.
3. Brady and Brown, Rock Mechanics for Underground Mining - 2nd edition, Kluwer Academic Publishers, 1993.
4. R. E. Goodman, Introduction to Rock Mechanics - 2nd edition, John Wiley and Sons, 1989.
5. John A. Hudson and John. P. Harrison, Engineering Rock Mechanics, An Introduction to the Principles - Pergamon Press 1997.
6. Brady and Brown, Rock mechanics for underground Engg. Chapman and Hall, 1993



4MI4-20: Rock Fragmentation Engineering Lab

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60 ETE: 40)

Course Objectives

- To familiarize the subjects with the design of blast for tunnel and blast for drift.
- To understand by experimental practices of rock fragmentation software, monitoring instruments, speed videography and blasting techniques.

Course Outcomes

- To know the application and procedure of each experiment and be able to do given processing techniques by using suitable apparatus/equipment and Software

Contents of the Subject

1. Design of blast for tunnel
2. Design of blast for drift
3. Application of high speed videography
4. Study of any blast vibrations monitoring instrument
5. Analysis of blast vibration using any rock fragmentation related software
6. Study of special blasting techniques



4MI4-21: Applied Mine Surveying Lab

Credit: 1
0L+0T+2P

Max. Marks: 100 (IA: 60, ETE: 40)

Objective Outcomes

- To understand by experimental practices and study of Processes, Methods, Measurements, Monitoring Instruments and Techniques of Mine Surveying.

Course Outcomes

- Student has knowledge to performance the experiments with different instruments, calculations and measurements of Area, Volume and curve setting methods by using Total station.
- To know the correlation survey by coplanation and Weisbach triangle method.
- Traversing and recording position of points by GPS

Contents of the Subject

1. Setting out of simple curve by offsets from long chord.
2. Setting out of simple curve by offsets from tangents.
3. Setting out of simple curve by Rankine's method.
4. Correlation survey by coplanation method.
5. Correlation survey by Weisbach triangle method.
6. Correlation survey by Weiss Quadrilateral method
7. Calculation of volume using Total Station.
8. Coordinate measurement using total station.
9. Coordinate measurement using GPS.



4MI4-22: Surface Mine Mechanization Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- To impart knowledge of operating different surface mine mechanization instruments and its accessories
- To impart knowledge of conducting various type of surface mines.
- To impart knowledge of applications of AI, machine learning and big data analytics in mine mechanization.

Course Outcomes

- To enhance the knowledge and concept of mine Hydraulic Shovel, Electric Rope Shovel, Arial Ropeway and dumper used in mines.
- To aware about Planned, preventive, predictive maintenance and monitoring in Mining industry.
- To know the processes and features of Surface Miner with neat sketch.

Contents of the Subject
<ol style="list-style-type: none">1. Study and sketch of Hydraulic Shovel.2. Study and sketch of Electric Rope Shovel.3. Principle, working and constructional features of Surface Miner with neat sketch.4. Study of dumpers and their specifications.5. Construction and working of Arial Ropeway.6. Role of condition monitoring in Mining industry.7. Planned, preventive and predictive maintenance.8. Automation and Productivity monitoring system in surface mines.9. Basics of applications of AI, Machine learning and Big Data Analytics in mine mechanization



4MI4-23: Safety, Health and Environment in Mining Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- To provide essential knowledge about hazards and assess the risks associated in mining operation.
- To aware the mechanism of various types of hazards associated with mining operations and device the relevant mitigation procedures.
- To understand the conversant with emergency management system and rescue procedures.
- To know the monitoring and control of various hazardous issues and parameters.

Course Outcomes

- To know about the types of hazards present in underground mine like fire, explosion and inundation etc.
- To acquire the Knowledge regarding the development and implementation of proactive Safety Management Plan.
- To gain knowledge on the rescue and recovery operations to be conducted in emergency situations in underground coal mines.

Contents of the Subject

1. Classification of various types of accidents.
2. Impact on Socio-Economic-Cultural changes due to mining industry.
3. Standards for water, air, noise, dust etc. and their impact when found in excess.
4. Measurement of dust contents with the help of dust sampler.
5. Measurement of dust by instruments used in mines.
6. Gravimetric dust sampler
7. Problem for Acid mine drainage
8. Site selection criteria for waste and tailings disposal sites
9. Selection of site for post mining land uses



4MI4-24: Applied Rock Mechanics Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- To impart the knowledge to the students about the determination of various rock properties in the laboratory.

Course Outcomes

- Understanding the concept of rock mechanics laboratory testing of rocks.
- Knowledge of rock mechanics testing apparatus/equipment used.
- Practical usage of rock mechanics testing apparatus/equipment.
- Practical experience on Sample preparation for different tests in laboratory.

Contents of the Subject

1. Practice in use of load cells, strain gauges.
2. Practice in use of dilatometers, extensometers, optical gauges, compressometers.
3. Estimation of “Q” for a given rock mass characteristics.
4. Application of rock mass classification in solving mining problems.
5. Design of support layout for a given area underground.
6. Estimation the subsidence area and damage to the surface.
7. Estimation of “RMR” for a given rock mass characteristics.
8. Estimation of stresses around mine openings.
9. Design of hydraulic stowing parameters.



4MI4-25: Introductory Computing Lab

Credit: 1

Max. Marks: 100 (IA: 60, ETE: 40)

0L+0T+2P

Course Objectives

- This course provides knowledge on development of various commands and IT tools applications in mining Industry.

Course Outcomes

- Knowledge of Auto CAD in planning
- Understanding the concept of Commands like Drawing, Editing, Enquiry etc.,
- Knowledge of FRAGLYST 2.0" and "FLAC/ FLAC 3D software and practical use in mining Industry

Contents of the Subject

1. Learning of the following commands using a CAD package.
2. Drawing Commands: Line, arc, circle; polygon, Donut, Solid, Spline Pline, Text, M Line, ellipse, dimensioning, object snaps point, Hatch, layers, Units.
3. Editing Commands: Limits, Erase, Array, Copy, Move, Offset, Stretch, Pedit, change properties, Trim, Extend, Fillet, Chamfer, Break, Mirror, Scale, Rotate, Zoom, Pan.
4. Enquiry Commands: Id, list, Dist, Area, DB list, Status Selection sets i.e. window, crossing, fence, W polygon. Plotting.
5. 8 exercises (mining drawing) using any of the above commands.
6. Introduction to "FRAGLYST 2.0" software.
7. Introduction to "FLAC/ FLAC 3D software