JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. Mining Engg.-I Sem	L	T/P/D	C
	4	-/-/-	4

(A72504) MINERAL PROCESSING

Objective:

The prime objective of this course is to build a solid foundation on Principles, equipment of various mineral beneficiation procedures that would facilitate metal extraction. It also focuses on mathematical derivations that are associated with concentration processes.

UNIT I

Scope and objectives of ore dressing. Sampling of ores by different methods. Theory of liberation of minerals. Crushers: -Jaw, Gyratory, Cone, Rolls and toothed roll crushers.

Types of grinding operations like batch and continuous dry and wet grinding, open circuit and closed circuit grinding. Grinding Mills: Ball mills, theory of ball mill operation, rod and tube mills. Comminution laws: - Rittinger's law, Kick's law and Bond's law.

UNIT II

Sizing: Study of laboratory sizing techniques and reporting of sizing data. Industrial sizing units: Types of screen surfaces. Grizzlies, trommels, vibrating and shaking screens.

Movement of solids in fluids: Stokes and Newton's laws. Terminal velocity and its relation with size. Relation between time and velocity. Relation between distance traveled and velocity. Equal settling ratio, Free and hindered settling ratios.

Quantifying concentrating operations: Ratio of concentration, recovery, selectivity index and economic recovery.

Classification of classifiers, study of settling cones, rake classifier, spiral classifier and cyclones.

UNIT III

Heavy media separation: Principles, flow chart, different media used. Heavy media separation using heavy liquids and heavy suspensions. Washability curves for easy, normal and difficult coal. Magnetic separation processes and electrostatic separation process

UNIT IV

Jigging: Theory of jigging. Jigging machines: harz jig, baum jig, and Hancock jig. Design considerations in a jig. Tabling: -study of stratification on a table. Shaking tables, wilfley table. Humphrey's spiral classifier.

UNIT V

Flotation: Principles of flotation. Factors affecting flotation. Classification of collectors, frothers and regulators. Factors affecting their efficiency. Flotation machines: Pneumatic and mechanical flotation cells. Application of flotation process for Cu, Pb and Zn ores.

TEXT BOOKS:

1. Principles of Mineral Dressing - A.M. Gaudin.
2. Mineral processing technology-B. A. Wills

REFERENCES:

1. Elements of Ore Dressing - A. F. Taggart
2. Ore dressing practices - S. K. Jain,

Outcome:

The student will be able to judge the concentration process for a particular mineral. He will also have complete understanding on principles, construction, and working of the equipment for concentration and classification.

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(A72526) ROCK MECHANICS

Objective: To give details of Mechanics of rock failure and other aspects of stability of underground and opencost workings including mechanics of subsidence, design of supports etc.

Unit-I

Physico-mechanical properties of rocks, Elastic and time dependent behavior, Rock mass classification.

Unit-II

Theories of rock failure, Stress analysis, Insitu stress and stress distribution around mine openings.

Ground failure and pressure on supports, Stability of wide openings, Design of supports in mine workings,.

Unit-III

Subsidence: Causes and impacts of subsidence, Mechanics of surface subsidence, discontinuous and continuous subsidence, Monitoring, prediction, control and management of subsidence.

Unit-IV

Mechanics of rock burst and bumps, Stability of slopes. Instrumentation and measurement of insitu stresses and rock strength, Photolasticity and scale model studies.

Unit-V

Basics of numerical methods in geomechanics with applications.

TEXT / REFERENCE BOOKS:

1. Coal Mining ground Control by Peng S.S
2. Rock Mechanics by Jumikis
3. Fundamental of Rock Mechanics by Jager & Cook.
4. Rock Mechanics – Brounden.

Out comes: This professional course contents encourage the students to study various aspects of ground control problems in underground and opencost mines with a better understandings of scope for application of various numerical methods and model studies in geomechanics.

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(A70352) OPERATIONS RESEARCH

UNIT – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT – II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III

Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming:

Introduction – Terminology- Bellman's Principle of Optimality – Applications

of dynamic programming- shortest path problem – linear programming problem.

Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOK :

1. Operations Research /J.K.Sharma 4e. /MacMilan.
2. Introduction to O.R/Hillier & Libermann/TMH.

REFERENCE BOOKS :

1. Introduction to O.R /Taha/PHI.
2. Operations Research/ NVS Raju/ SMS Education/3rd Revised Edition.
3. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research / Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K, Vijaya Kumar Reddy, J. Suresh Kumar/ Cengage Learning.

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(A72522) MINE LEGISLATION

Objective: introduces mining laws and legislation to the students with basic knowledge on mining engineering aspects. It poses the student to indian electricity Rules, Vocational Training. Principles of management, industrial relations etc.

Unit-I

Introduction to mining laws and legislation, General principles of mining laws, development of mining legislation of India. Acts, Rules and Regulations, Mines Act, Mines Rules. Coal and matalliferous mines regulations, Bye-laws, Circulars, and standing orders,

Unit-II

Indian electricity rules, coalmines conservation and development act, Workman's compensation act., General provisions of Mines and Minerals Regulation and Development Act, Mineral Concession Rules.

Unit-III

Vocational Training. Rules, crèche rules, Maternity benefit act, Payment of Wages Act, Gratuity and P.F. Rules, Explosives act, Rescue Rules, Factory Act, Environmental protection Act.

Unit-IV

Safety organization; role of management, supervisors and workers; pit safety committees; workmen's inspector; role of safety officers. Classification of Accidents; Statistics, causes and prevention of accidents. Accidents rate in Indian mines. Accident enquiries and reports, health of workmen. Occupational disease in mining.

Unit-V

International labor organization and its model code in the field of safety and accident prevention. Principles of management and organization. Industrial relations. Welfare organizations. Development of safety consciousness; interest, publicity and propaganda for safety, audio-visual aids, safety drives campaigns.

TEXT BOOKS

1. Principle Acts & Rules CMR and MMR.

REFERENCE BOOKS:

1. Intent and Content of Mine Legislation – Prasad.

Outcomes: As the outgoing students career is mainly dependent on mining industry, exposure to state and central laws related to mining are highly solicited. This course gives an opportunity for the students to understand the statutions requirement for coal/metal mining by opencost/underground methods.

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(A72527) ROCK SLOPE ENGINEERING

(Elective-I)

Objective: To give details of slope design principles for opencost mines including basic mechanism of slops failure, monitoring and instrumentation and remedial measures for slope stabilisation

Unit-I

Introduction: economic implications, geological investigation, data interpretation for slope stability analysis.

Unit-II

Basic Mechanism of Slope Failure: Planer, wedge, rotational shear, toppling, buckling and rock fall.

Mechanism of failure of jointed rock mass. Determination of shear strength of discontinuities.

Unit-III

Influence of ground water on slopes and techniques of depressurization, remedial and corrective measures. Remedial measures for slope stabilization.

Unit-IV

Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes.

Unit-V

Numerical analysis of slopes. Use of FLAC Software.

TEXT BOOKS:

1. Fundamentals of Rock Mechanics by Jager & Cook.
2. Chowdary R.N. – Slope Analysis.

REFERENCE BOOKS:

1. Cumming A.B. & Given I &V. & SME Vol. I & II, Society of Mining Engineers , USA.
2. Heartman H.L. – Introduction to Mining Engineering, John Willey & Sons.
3. Walker B.F. Fell . R. – Soil Slope Instability and Stabisation.
4. Rock Mechanics by Jumikis.
5. Rock Mechanics by Brounden.

Outcomes: At present opencost mining methods are being practical for extraction of mineral deposits at comparatively deeper horizans and experiencing slope stability problems as a challenge t mining engineers. Students can get a better knowledge on various slope failures, design of slopes and monitoring of stability of slopes and its stabilization measures as an outcome of this course.

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(A72523) MINE SUBSIDENCE ENGINEERING

(Elective-I)

Objective: To familiarize the student with the specialized knowledge on mechanism, predication, control of subsidence due to underground mining.

Unit-I

Introduction: Strata movement at the mining horizon, convergence in mine working, factors influencing convergence in mine working.

Unit-II

Subsidence Mechanism: Zones of movement in the overlaying beds, vertical and horizontal movement, subsidence trough, angle of draw, angle of break, sub-surface subsidence.

Unit-III

Subsidence Prediction: Different methods of surface subsidence prediction – graphical, analytical, profile function, empirical and theoretical models.

Unit-IV

Time Influence and Impact on Structures: Influence of time on subsidence, example from long wall and bord and pillar working. Calculation of ground movement over time. Types of stress on structures, stress-strain behaviour of soils, mining damage to buildings, industrial installations, railway lines, pipes, canals, etc.,

Unit-V

Subsidence Control, Governing Laws and Standards: Measures to reduce mining damage, mining methods to minimise damage. Laws governing mining damage, different standards suggested fro mining and building ground in respect of subsidence. Case statues of Mine subsidence

TEXT / REFERENCE BOOK:

1. Whiltaker B.N. Reddish D.J. - Subsidence occurrence prediction and control.
2. B. Singh – Mine Subsidence.
3. Peng .S. – Surface subsidence Engineering.
4. Kratzsch. H.,- Mine Subsidence Engineering.

Outcomes: Students will get an opportunity to understand the effects of underground mining on the surface and subsurface structures, design of methods to minimize the damage to structures and laws governing mining subsidence.

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IV Year B.Tech. Mining Engg.-I Sem

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(A72524) ROCK EXCAVATION ENGINEERING

(Elective-I)

Objective: Aimed at specialized knowledge on drilling, blasting, rock cutting technologies related to opencast and underground excavations.

Unit-I

Scope and importance, Rock excavation engineering in mining and construction industries; Physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation method; selection of excavation method.

Unit-II

Drilling: Mechanics of rock drilling, design and operating parameters of surface and underground drilling, evaluation of drill performance, drill ability of rocks, mechanism of bit Wear, bit selection, problems of drilling, economics of drilling.

Unit-III

Blasting: mechanics of rock fragmentation by explosives, advances in explosives and their selection criteria for rock excavation, blast design for surface excavations and optimization. Advanced blast initiation systems, blast performance evaluation, cast blasting, technoeconomic and safety aspects of surface and underground blasting.

Unit-IV

Advances in blast design for underground excavations, contour blasting, computer aided blast designs, review of tunnel blasting techniques in recent advances.

Unit-V

Rock Cutting: Theories of rock tool interaction for surface excavation machinery – rippers, bucket wheel excavators, continuous surface miners; theories of rock tool interaction for underground excavation machinery-Ploughs, Shearers, road headers, continuous miners, Tunnel boring machines, selection criteria for cutting tools; advanced rock cutting techniques – high pressure water jet assisted cutting.

TEXT / REFERENCE BOOKS

1. Cark G.B – Principles of Rock fragmentation, John Wiley & Sons.
2. Chugh C.P. – Diamond Drilling, Oxford Publication.

Outcomes: Mining engineers specialized in various aspects of excavation technologies including recent concepts of blastless mining with continuous miners/surface miners to drilling/blasting designs is expected as an outcome of the course.

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(A72525) ROCK FRAGMENTATION ENGINEERING

(Elective-I)

Objective: To familiarize the students with highly specialized subject of design of rock breaking techniques with more emphasis on computational models, controlled blasting, instrumentation for monitoring blasting operations in mines.

Unit-I

General theory of rock cutting, selection of cutting tools for optimum penetration and wear characteristics.

Mechanics of rotary, percussive and rotary-percussive drilling, short and long hole drilling equipment, different types of bits, bit wear, drilling in difficult formations, drillibality of rocks, drilling performance and costs.

Unit-II

Mechanism of rock breaking machines, Pneumatic and Hydraulic rock hammers. Mechanics of rock fragmentation and fracture by explosive action, explosive. Blasting accessories, blasting parameters, design of blasting rounds for opencast and underground mines, Blastability of rocks, blasting efficiency, mean fragment size.

Unit-III

Computational models of blasting, transient ground motion, misfires, blown out shots, incomplete detonation – their cases and remedial measures.

Unit-IV

Controlled blasting techniques, perimeter blasting, safety precautions, ground vibrations and air over pressure from blasting.

Unit-V

Instrumentation in blasting, Borehole pressure transducer, V.O.D probe, vibration monitor, high speed video camera. Impact of ground vibration and sound on the neighboring structures and communities, and mitigative measures.

TEXT / REFERENCE BOOKS:

1. Pradha G.K., Ghosh A.K. 'Drilling & Blasting' Mine Tchnology
2. Sastry V.R. – 'Advances in Driiling & Blasting'

Outcomes: Although shotfirer supervisor the drilling and blasting operation statutorily any mines, students are expected to have detailed knowledge on rock fragmentation techniques. This course enable the student to have clear perception of rock fragmentation techniques and its field applications.

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(A72520) MINE ECONOMICS

(Elective-I)

Objective : To familiarize the student with economic issues related to mining industry such as mine valuation, mine accounts, application of geostatistical techniques, assaying, estimation of ore reserves, preparation assay plants etc.

Unit-I

The Mineral Industry: Economic characteristics of the mineral industry in India and world , the place of minerals in the national and international economy.

Unit-II

Brief survey of India's mineral resources in the world setting with special reference to its need and deficiencies.

Unit-III

Mining companies and mine Accounts: Structure, formation and capitalization, principles of book keeping as applied to the mining industry presentation of accounts, balance sheets and profit and loss accounts, Depreciation DCF, IRR. Mine Valuation: Mineral reserves mining reserve and profit examination and report on mines.

Unit-IV

Mineral property planning valuation of mines, Mine properties, mine investments. Project planning and project evaluation. Sampling: Principles of sampling off prospect sampling methods classification and description, statistical and geo statistical techniques in mine sampling, sampling and grading of coal.

Unit-V

Assaying: Five methods of assaying for gold and silver cupellation Scarification, etc. wet assaying, theory, principle methods of wet assaying of copper aluminum, lead, zinc, Iron Manganese and Chromium ores. Insitu assay. Preparation of Assay Plans: Longititudinal section, calculation or ore reserve.

TEXT BOOKS/REFERENCES:

1. Deshmukh RT "Mineral Economics" Meera Publishers, Nagpur.
2. Chatterjee KK "Mineral Economics" Willey Estern.
3. Rubawsky "Mineral Economics" Elsvvier Science pub.

4. Sharma N.L. "Mineral Economics".

Outcome:- Any industry' sawdral depends largely on profit besides other parameters, and mining is no exception. Details of the course enable the student to understand various issues related to finance /Accounts starting from project planning stage presentation of account, balance sheet etc as outcome of the course

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(A72518) COMPUTER APPLICATIONS IN MINING

(Elective-II)

UNIT-I

Introduction to structure terminology and peripherals, algorithms, flow charts, programs, dedicated systems.

Application in mining, Exploration, rock topographic models, bore hole compositing, ore reserve calculation, interpolation and geostatical models.

UNIT-II

Open pit design, Ultimate pit design, introductory process control, underground mine design, production scheduling.

UNIT-III

Operational Simulation, Introduction, Simulation overview, objective, understand the role of modeling, Understanding the basic concept in simulation.

Example of simulation in mining aspects, Simulation of machine repair problems, concepts of variability and prediction, example with dumping time problem, fitting distribution with chi-square test.

UNIT-IV

Random number generation, properties of random number, pseudorandom number, random variates generation, Methods of random variates generation, inverse transformed method, acceptance rejection method, composition method, empirical method and rectangular approximation.

UNIT-V

Simulation languages, GPSS and SLAM, Logical flow diagram of different mining activities.

Coding with GPSS and SLAM of different mining problems, Computer control, Remote Control, automatic Control, application an limitations of control.

TEXT BOOKS:

1. T.C. Bartee, Digital Computer Fundamentals, Mc Graw Hill, 4th Ed., 1984
2. P. Malvino and D.P. Leach, Digital Principles and applications Mc Graw Hill, 5th Ed., 1994

REFERENCE BOOK:

1. R.V. Ramani, Application of Computer Methods in the Mineral Industry.

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(A72519) MINE CONSTRUCTION ENGINEERING

(Elective-II)

Objective: To give details of mine construction for the students qualified in the basic mining engineering subjects such as mine development. Underground open cast mining methods etc. Design and procedures for construction of mine opening including shafts, inclines trenches, haul roads. Put top and pit bottom layouts etc are in deeded in this course.

Unit-I

Size of mine Environment and ecology, selection criteria for site of the openings geological investigation.

Unit-II

Underground mine shaft sinking methods through alluvium, soft and hard rock, Mechanization, consolidation of loose ground shaft lining , ground pressure, thickness of lining.

Unit-III

Design and procedure of laying the lining, construction of shaft collar heapstead.

Design and construction of insets, shaft bottom, excavation for mechanized decking of cages, skip loading, pit bottom lay outs, installation of main haulages.

Main sump size, construction under ground substation, first aid room and office.

Unit-IV

Surface inclines, drivage through soft and hard rock, construction and lining of inclines, lateral and vertical and vertical pressures. Under ground development, drivage of roads in stone and coal, mechanization support systems opening of faces.

Surface layouts pit top circuits and coal handling and coal preparation plant, railway sifting and weigh bridges, surface and underground coal bunkers winding house substation, lamp room. Pit head bath, crèche dispensary: office, work-shop, material handling stowing installations, bunker, water tanks, mixing chamber.

Unit-V

Open pit mines opening out trenches, haul roads, construction of benches. Assembling and transporting of draglines, shovels etc. Scheduling for mine

constructions PERT/CPM

SUGGESTED TEXT BOOK/REFERENCE:

1. Pazdziora J. "design of Underground hard coal mine"
2. Popov "working of Mineral Deposits"
3. Bokey "Mining"
4. Rzhevsky Unit operations in open cast mines.

Outcomes: students can learn various aspects o mine construction for both underground and open cast mines. It helps in management of construction activities in mines effectively with better understanding of many civil engineering concepts for mining engineers as an out come of this course.

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(A72529) TUNNELING ENGINEERING

(Elective-II)

Objective: To familiarize the students with the recent trends in tunneling methods including design of supports, maintenance of tunnels, provision of facilities such as ventilation, illumination etc in tunnels.

UNIT-I

Introduction to tunneling; geological concept of tunneling.

Influence of geological aspects on design & construction of tunnels.

UNIT-II

Tunneling Methods: Conventional and special Drill & blast roadway drivage machines, tunnel boring machines (TBM)

UNIT-III

Stresses and displacements associated with excavating tunnels, Ground control or treatment in tunneling and drivages.

Design of Supports of Tunnels; Steel supports, rock enforcements, new Australian tunneling methods (NATM)

UNIT-IV

Design of Tunnels: Rock conditions, RMR, Q-system, RSR, rock mass behaviour, stress strain behaviour, and stress analysis of tunnels.

Maintenance: Dewatering, ventilation and illumination drivages tunnels.

UNIT-V

Numerical techniques: Introductory use of FLAC, PLAXIS etc.

TEXT BOOKS:

1. Richards E. Bullock – Tunnelling and Underground Construction Techniques
2. Stack Barbara – Hand Book of Mining and Tunnelling Machinery, John Wiley & Sons.

REFERENCE BOOKS

1. R.V. Proctor – Rock Tunneling with Steel Supports
2. J. Johnsen – Modern Trends in Tunneling and Blast Design.

Outcomes: Students can understand various methods of tunneling use of latest numerical techniques for tunnel design, stability analysis and ground control measures withy various steel support and rock reinforcement.

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(A72528) STRATA CONTROL TECHNOLOGY

(Elective-II)

Objective : In spite of increasing trend of accident due to starter control problems in India, and establishment of "STRATA CONTROL CELL" in all coal mine areas, application of scientific approaches for strata control called not be achieved satisfactorily. Hence, the course aims at specialized techniques for strata control in underground coal mines with topics on softer statics, strata behavior studies, organization of strata control cell etc.

Unit-I

Geo mining conditions: Geological factors contributing to strata control problems in mines, Geo mechanics classification of rocks.

Unit-II

Safety status: Status of safety in coal mines vis-à-vis strata control problems, Assessing the risk from the hazards of roof & side falls.

Unit-III

Design of support system: Design of support system for development and depillaring workings.

Design of support system for long wall workings, application of modeling techniques to strata control problems

Unit-IV

Strata behaviour studies: Instrumentation for evaluation of strata condition in coal mines, Strata control techniques and its application to coal mining industry.

Case studies on geotechnical instrumentation and strata control in coal mines.

Demonstration of geotechnical instrumentation and computer softwares.

Unit-V

Organization of strata control cell: strata control cell in mines, Training needs of the first line supervisors for effective implementation of the latest strata control technologies.

TEXT BOOKS:

1. Jeremic M L, Strata mechanics in coal mining, A A Balkema, Rotterdam, Taylor and Francis, 1985, 566p
2. T. Bieniawski Ziti, Strata Control in Mineral Engineering, New York, John Wiley & Sons, 1 Feb 1987.

REFERENCE BOOKS:

1. T.N. Singh, Underground winning of Coal, Oxford and IBH New Delhi, 1992.
2. B.H.G. Brady and E.T. Brown, "Rock Mechanics for Underground Mining" George Allen and Unwin Ltd., 1992.
3. J.A. Hudson, "Comprehensive Rock Engineering", Pergamon Press, UK, 2000
4. Bieniawski Z.T. 1989, Engineering Rock Mass Classifications, Wiley, New York, 251
5. Peng S S and Chiang HS. Longwall mining, Wiley, New York, 708p.

Outcomes: Future mining in complex geomining conditions demand innovative strata control technologies to be adopted for safe and stable mining structures. This course gives in depth knowledge to deal with strata control problems, especially in underground coal mines.

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(A72582) MINERAL PROCESSING LAB

Objective:

This course is mainly designed to make the student to understand and determine the process variables in various mineral beneficiation treatments employed. The characteristics of mineral particles like size, size distribution etc. are also evaluated.

List of Experiments

1. Sampling of an ore from the bulk by
   i) Coning and quartering method
   ii) Riffle sampler methods
2. Sizing by Sieve analysis of crushed ore
3. Verification of Stokes Law.
4. Determining the reduction ratio of a jaw crusher.
5. Study of the variation of reduction ratio with process variables in Rolls crusher.
6. Study of the process variables on reduction ratio and particle size distribution in ball mill.
7. To find the grindability index of ores.
8. Verification of Laws of comminution. (study)
9. Determination of the efficiency of a magnetic separator.
10. Determination of the efficiency of a jig. (study)
11. Study of the particle separation by fluid flow using Wilfley table. (study)
12. To study the concentration of metallic and non-metallic ores by Froth-Flotation process. (study)

Equipment:

1. Riffle Sampler
2. Sieve Shaker with Sieves
3. Stokes' Apparatus
4. Jaw Crusher
5. Roll Crusher
6. Ball Mill
7. Grindability Index Apparatus

8. Magnetic Separator
9. Jig
10. Wilfley Table
11. Froth – Floatation Equipment
12. Balances

Outcome:

The student will be able to choose the appropriate equipment and regulate the process parameters for the required mineral beneficiation technique.

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(A72587) ROCK MECHANICS LABORATORY

1. Determination of RQD of rocks.
2. Determination of Protodyaknov index of a given rock sample
3. Determination of point load index strength of a given rock sample
4. Determination of porosity of rocks.
5. Determination of hardness of rocks
6. Determination of uniaxial compressive strength of a given rock sample
7. Determination of tensile strength of a given rock sample using Brazilian method
8. Determination of shear strength of rocks
9. Determination of modulus of elasticity of given rock sample using strain gauge.
10. Determination of triaxial strength of rock and drawing of Mohr's envelope
11. Determination of slake durability of rocks
12. Study of time dependent properties of rocks.
13. Study of drillability index of rocks.
14. Study of different types of supports used in mines
15. Study of stress and fracture patterns around underground model opening
16. Study of design of mine pillars.
17. Prediction of Subsidence.
18. Study of measurement of in situ stresses and strengths.
19. Determination of rock anchorage capacity of a rock bolt
20. Study of different types of roof convergence and other ground control instruments.