

**REVISED CURRICULUM
OF
Mining Engineering**

**Curriculum Development Project
Sponsored by
Ministry of Science & Technology
Islamabad**



**HIGHER EDUCATION COMMISSION
H-9, ISLAMABAD
2003**

CURRICULUM DIVISION, HEC

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*Composed by **Mr. Zulfiqar Ali**, HEC, Head Office, Islamabad*

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed Higher Education Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the special meeting of Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The National Curriculum Revision Committee on **Mining Engineering** in its meeting held in June 2003 at the H.E.C. Regional Centre, Peshawar finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
D.G. (CURRICULUM)

October 2003

INTRODUCTION

The National Curriculum Revision Committee final meeting for **Mining Engineering** held on June 17-19, 2003 at HEC Regional Centre, Peshawar, to finalize draft curriculum prepared in its preliminary meeting held on October 15-17, 2002 at the Higher Education Commission, Islamabad.

The following attended:

1. Engr. Dr. M. Mansoor Khan, Convener
Professor,
Department of Mining Engineering,
NWFP University of Engineering & Technology,
Peshawar.
2. Prof. Dr. Syed Abid Hussain Rizvi Member
Chairman,
Department of Mining & Geological Engg.,
University of Engg. & Technology,
Lahore.
3. Engr. Riaz Ahmad Batth, Member
General Manager,
Pakistan Mineral Dev. Corporation,
Sector H-9, Islamabad.
4. Engr. Dr. Noor Muhammad, Member
Associate Professor,
Department of Mining Engineering,
NWFP University of Engineering & Technology,
Peshawar.
5. Engr. Dr. Muhammad Ali Shah, Secretary
Professor,
Department of Mining Engineering,
Mehran University of Engg. & Technology,
Jamshoro.

The meeting started with the recitation from the Holy Quran by Mohammad Tahir Ali Shah, Assistant Director, HEC, Islamabad. He welcomed the participants of the meeting on behalf of the Chairman, HEC, and briefed them of the obligations of the Commission to review, revise curriculum as per provision of the Act of the parliament 1976.

The committee before taking up the regular agenda unanimously agreed to continue **Prof. Dr. M. Mansoor Khan** as its Convener and select **Dr. Muhammad Ali Shah** as Secretary due to non attendance by Dr. Syed M. Tariq, UET, Lahore.

Prof. Dr. M. Mansoor Khan, Convener of the committee welcomed the participants and thanked for reposing the confidence in him. He also thanked the following universities/organizations for sending their representative to participate in the important national cause:

1. NWFP University of Engineering & Technology, Peshawar.
2. Mehran University of Engg. & Technology, Jamshoro.
3. University of Engg. & Technology, Lahore.
4. Pakistan Mineral Dev. Corporation, Sector H-9, Islamabad.
5. Pakistan Engineering Council, Islamabad.

The committee thanked and appreciated the previous NCRC on Mining Engineering for their efforts and useful deliberations.

The Convener invited each of the member to express their views.

The NCRC discussed at length on different aspects of the syllabi of Mining Engineering.

Scheme of Studies for BE/B.Sc.

The following subjects of Mining Engineering discipline have been recommended as essential subjects to fulfill the requirements of BE/B.Sc degree programme.

	<u>CREDIT HRS</u>	
	<u>Theory</u>	<u>Practical</u>
<u>1st Terms</u>		
1. Applied Calculus	3	0
2. Applied Chemistry	3	1
3. Applied Electricity	3	1
4. Engineering Drawing and Graphics	1	2
5. General Geology	3	1
<u>2nd Term</u>		
1. Linear Algebra and Analytical Geometry	3	0
2. Applied Thermodynamics	3	1
3. Workshop Practice	0	2
4. Introduction to Mining Engineering	3	1
5. Islamiat and Pakistan Studies	3	0
<u>3rd Terms</u>		
1. Differential Equations and Fourier Series	3	0
2. Fluid Mechanics	3	1
3. Industrial Minerals of Pakistan	3	0
4. Structural Geology	3	1
5. Mine Surveying-I	1	2
<u>4th Terms</u>		
1. Computer Science and Numerical Analysis	3	1
2. Strength of Material	3	1
3. Engineering Statistics	2	0
4. Mine Surveying-II/Field Survey	1	2
5. Communication Skills	2	1
<u>5th Terms</u>		
1. Basic Metallurgy	2	1
2. Rock Mechanics	3	1
3. Mine Power Drainage and Material Handling	3	0
4. Mine Ventilation	3	1
5. Mineralogy and Petrology	2	1

6th Terms

1. Coal Technology	2	1
2. Under Ground Hard Rock Mine Design	3	1
3. Mineral Exploration	2	1
4. Principles of Explosives Engineering	3	1
5. Drilling Technology	3	1

7th Terms

1. Mine Economics	2	1
2. Strata Control	2	1
3. Mine Rescue and Safety	2	1
4. Excavation Engineering	3	0
5. Mineral Processing-I	3	1
6. Project (Part-1)	0	2

8th Terms

1. Mine Management	2	0
2. Surface Hard Rock Mine design	3	1
3. Mining Law	2	0
4. Mineral Processing-II	3	0
5. Project (Part-II)	0	2
6. First Aid	0	1

ADDITIONAL SUBJECTS

1. Applied Physics
2. Applied Mechanics
3. Mine Environmental Engineering
4. Introduction to Gemology

NOTE:

- **Term/Semester: 15-16 weeks of classes, followed by 1 – 2 weeks of examination. Total duration 16-18 weeks.**
- **Credit Hour: 1 hours (50 to 60 minutes) of lecture per week for the semester. Normal courses are 3 credit hours each i.e. 3 hours of lecture per course per week. For laboratory, 1 lab credit hours means 3 hours in the laboratory per week for the semester.**

- *The total number of credit hours for ANY degree programme should therefore be between 124 and 134.*
- *Final Year project should be of two terms/semesters duration and will equal one 4 credit hour course in semester 7 and semester 8.*
- *Internship should be 6 – 8 week duration during the summer following completion of 3rd year of study.*
- *To provide breadth, as well as technical depth, it is recommended that at least one humanities and social science or management elective course be given each semester. These courses should emphasize oral and written communication skills.*
- *The additional subject may be introduced in the normal curriculum if it is required.*
- *M.Sc Mining Engineering courses are also recommended. The minimum credit hour for awarding 32 – 36 credit hours.*

-Sd-
PROF. DR. M.A. SHAH
SECRETARY (NCRC)

-Sd-
DR. M. MANSOOR KHAN
CONVENER (NCRC)

20th September, 2003

Detail of Courses for BE/B.Sc.

APPLIED CALCULUS

Introduction to functions:

Mathematical and physical meaning of functions, graphs of various functions. Hyperbolic functions.

Introduction to limits:

Theorems of limits and their applications to functions. Some useful limits, right hand and left hand limits. Continuous and discontinuous functions and their applications.

Derivatives:

Introduction to derivatives and their geometrical significance. Application, problems, rate of change for marginal analysis.

Higher derivatives:

Leibnitz theorem, Rolle's theorem, mean value theorem. Taylor's and Maclaurin's series.

Evaluation of limits using L'Hospital's rule:

Indeterminate forms $(0/0)$ (∞/∞) , $(0 \times \infty)$ $(\infty - \infty)$, 1^∞ , ∞^0 , 0^0

Applications derivatives

Asymptotes, tangents and normals curvature and radius of curvature, maxima and minimum of a function of single variable (applied Problems), differential with application.

Applications of partial derivatives:

Euler's theorem, total differentials, maximum and minimum of two variables

Integral calculus:

Methods of integration by substitutions and by parts. Integration of rational and irrational algebraic functions. Definite integrals, improper integrals. Gamma and Beta functions, reduction formulae.

Applications of integral calculus:

Cost function from marginal cost, rocket flights, area under curve.

Vector algebra:

Introduction to vectors.scalar and vector product of three and four vectors.
Volume of parallelepiped and tetrahedron.

Vector Calculus

Vector differentiation, vector integration and their applications, operator, gradient, divergence and curl with their applications.

APPLIED CHEMISTRY**Physical & Analytical Chemistry**

Physio-chemical principles involved in chemical analysis, instrumental methods of analysis, industrial catalysis.

Radioactivity and its measurement, nuclear fuels and nuclear power reactor, use of radioisotopes in industry.

Electro Chemistry

Electrochemical cells; reaction in cells, electro potential; secondary cells, electroplating, metallic corrosion; electro refining; pH; its significance and determination, fuel cells.

Boiler Water Treatment

Boiler water, scale and sludge, measurement of hardness, softening of hard water.

Lubricants

Lubricating oil from crude oil, de-waxing and refining greases, synthetic lubricants; composition and properties of lubricants in general.

Protective coating

Water paints, oil paints, cellulose paint, varnishes, lacquers, and metallic coatings.

Composite materials: Introduction to composite materials.

PRACTICALS

- 1) Chemical analysis of the cement

- 2) Chemical analysis of limestone and lime mortars, proximate and utilization analysis of coal.
- 3) Determination of calorific value of different fuel
- 4) Study of the effects of temperature on the viscosity's of liquid fuels.
- 5) Qualitative analysis of mixture, salts containing four radicals.

Recommended Books:

Text Books

1. Applied chemistry for engineers by Gyngel
2. Inorganic qualitative analysis by V.I. Vogel.

Reference books:

1. Physical Chemistry by Adamson
2. Principle of Surface Chemistry by Warrner Stumm
3. Industrial Chemistry for Engineers by C.C. Furants

APPLIED ELECTRICITY

CIRCUIT THEORY

Solution of D.C. Circuits by Ohm's law and Kirchoff's laws, R.L.C., series and parallel circuits calculation of power in single and three phase circuits.

A.C and D.C. MACHINES

Transformer emf equation, losses and efficiency, open circuit and short circuit tests. Three phase transformer connection construction and operation of synchronous machines, construction, operation and starting methods for 3-phase induction motor, including slipring motor. Construction operation of single phase motors i.e. split-phase, capacitor, shaded pole and universal motors.

Construction and characteristics of series, shunt and compound generators and motors, emf and torque equations, starter and speed control of motor.

SWITCH GEARS

Construction and characteristics of vacuum diodes and triodes. Rectification by vacuum diodes. Metal Silicon rectifiers, simple construction and operation of cathode ray oscilloscope.

INTRODUCTION TO ELECTRONICS

Semiconductor Fundamentals: Germanium and Silicon atoms and Crystals. Conduction in Intrinsic Germanium and Silicon. N and P-Type of Semiconductors Conduction in Doped Germanium and Silicon.

The PN Junction. Diode biasing. Diode Characteristics. Diode Ratings. Temperature Considerations. Diode Construction. Diode Applications.

MINE ELECTRIFICATION

Principles of Mine electrical circuits required power calculations. Design of electric cables control devices, Earthing.

ELECTRICAL INSTRUMENTS AND MEASUREMENTS

Deflecting, controlling and damping devices, moving coil and moving iron ammeters and voltmeters. Electro-dynamic and dynamometer instruments. Measurement of resistance, ohm meter, wheat-stone bridge, single phase energy meter (induction type).

SUPPLY SYSTEMS

Introduction to supply systems and equipments: comparison of supply system-overhead line conductor and insulators (pin type-cap and pin type insulator) underground cables, single core and 3-core solid type cables. Fuses and circuit breaker, tariffs.

PRACTICALS

Based on the above course work and facilities available.

Recommended Books:

Text Books

1. Electrical Technology by Hughes
2. Electrical Technology by B.L. Theraja

Reference Books:

1. Electrical Circuits, Basic Electricity. Schaum's Series. McGraw Hill.

ENGINEERING DRAWING AND GRAPHICS

GEOMETRICAL DRAWING

Orthographic projection, first angle and third angle projection, projection of points, projection of lines in simple position and inclined to both the planes. Projection of solids in simple position and inclined to both the planes.

Section of solids and auxiliary views, Development of surfaces.

Pictorial projection such as isometric and oblique view.

Conic section, cycloidal curves, spirals and involutes. Planning and Drawing, lettering and dimensioning rivets, riveted, joints, screws and screwed fastening, keys, cotter, pulleys.

ASSEMBLY MACHINE DRAWING

Preparation of details and assembly drawing in pencil of subjects selected from the following:

Bearings, Wall-brackets, Shaft Couplings, Engine Pistons, Engine Rods connecting Rods, Stuffing Boxes.

Introduction to electronic machines and CAD CAM

Recommended Books:

Text Books

1. Engineering Drawing by N.D. Bhatt, P.R. Patel, Pradeep Publications.
2. A first year Engineering Drawing by A.C. Parkinson, Pitman and sons.

Reference books

1. Practical Geometry and Engineering Graphics by Abbot, Blackie Son Ltd.
2. Engineering Drawing by Craft, Meyers and Boyer.
3. Engineering Drawing and Graphic technology by T.E. French, C.J. Vierck and R.J. Roster, McGraw-Hill.

GENERAL GEOLOGY

Introduction to various branches of geology. Origin of the earth and its place in universe, interior of the earth and chemical composition of the earth's crust.

Mountain building and valley formation, drainage patterns and their types, agents of weathering and erosion.

Deformational structural features of rocks, dip, strikes, fault, folds, unconformities etc.

Introduction to continued drift and plate tectonics, earth quakes and volcanism.

Formation of rocks and minerals, classification of rocks.

Occurrence of economic minerals and dimension stones of Pakistan.

PRACTICALS:

1. International geological symbols for rocks, structures and minerals
2. Geological map reading
3. Moh's Scale Hardness
4. Identification of rock forming minerals
5. Study of wooden models of faults and folds etc.

Recommended Books**Text Books**

1. Text book of Geology by K.M. Banger

Reference Books

1. Physical Geology by Arthur Holmes and Dorris Holmes
2. Geology for Engineer by F.G.H. Blyth

LINEAR ALGEBRA AND ANALYTIC GEOMETRY**Introduction to Matrices Elementary row Operations and Vector Spaces:**

Brief introduction to matrices. Symmetric and hermitian matrices. Introduction to elementary row operations. Echelon form and reduced echelon form. Rank of a matrix Inverse of a matrix by using elementary row operations. Vector subspaces. Linear combination. Linear dependence and basis. Linear transformation.

System of Linear Equations:

System of non-homogeneous and homogenous linear equations. Gaussian elimination method, Gauss Jardon method. Consistency criterion for solution of homogeneous and non-homogeneous system of linear equations. Applications of system of linear equations.

Determinants:

Introduction to determinants. Properties of determinants of order. Axiomatic definition of a determinants (Cramer's Rule).

Multiple Integrals:

Definition, double integral as volume, evaluation of double integral, change of order of integration. Application of double integrals, area, mass of an element, moment of inertia, centre of gravity. Triple integrals, evaluation of triple integrals, application of triple integrals, volume, mass of an element, center of gravity, moment of inertia by triple integrals, triple integration in cylindrical and spherical coordinates.

Analytic Geometry of 3-dimensions:

Introduction Coordination of a point dividing a line segment in a given ratio. Straight line in R³: Vector form of a straight line, parametric equations of a straight line, equation of a straight line in symmetric form, direction ratios and direction cosines, angle between two straight lines, distance of a point from a line.

Planes:

Equation of a plane, angle between two planes, intersection of two planes, a plane and a straight line, skew lines. Cylindrical and spherical coordinate: introduction to cylindrical and spherical coordinates.

Surfaces:

Quadratic surfaces, degenerate surfaces, symmetry, traces, intercepts of the surfaces, surface of resolution.

Cylinder and Cone:

Cylinder, directrix of cylinder, right cylinder. The cone.

Sphere:

General equation of sphere, great circle

Conics:

Ellipsoid, elliptic parabolic, hyperbolic parabolic, hyperboloid of one sheet, hyperboloid of two sheets, elliptic cone, ruled surfaces, general quadratic surfaces.

Spherical Trigonometry:

The cosine, sine, cotangent formulae. Latitude and longitude, direction of Qibla.

APPLIED THERMODYNAMICS

Thermodynamics systems; state property, process and cycle, 1st Law of thermodynamics, internal energy, perfect gases and their laws, constant specific heat.

Expansion and compression of gases, properties of vapours, p-v diagrams, elementary cycles and applications.

Description and elementary theory of compressors, boilers, steam engines, I.C. engines, refrigerators, engine tests, heat balance, elementary theory and description of nozzles, steam turbines and gas turbines, combustion of fuels.

PRACTICALS

Based on the above course work and facilities available.

Recommended Books:

Text books.

1. Thermodynamics Applied to heat Engines by E.H. Lweitt.

Reference books:

1. Applied thermodynamics for Engineering Technologist by T.D. Eastop and A.McConkey.

WORK SHOP PRACTICE

ELEMENTARY MACHINE SHOP

Detailed study of Centre lathe and accessories. Plane and Taper turning simple screw cutting. Cutting tools and their grinding. Introduction of shaper, Slotter, Planner, Pillar and Radial Drilling Machines.

FITTING SHOP

The use and care of fitter's tools. Marking out of job. Practice in Metal Filing. Sawing, Drilling. Dieing. Taping and Reaming. Introduction and use of Power Hack Saw and Arbor press.

SMITHS SHOP

The use and care of forging tools and blacksmith open hearth forge, practice in upsetting, drawing out spreading bending cutting and punching. Hardening and tempering of small cutting tools, Forge welding.

CARPENTRY SHOP

The use and care of tools, timber, its defects and preservation methods. Practice in planning and sawing different types of wood joints. Study of sawing, planning truing mortising and tenoning machines.

ELECTRICAL SHOPS

The used and care of tools used by Electrician. Types and uses of cables and electrical accessories for house wiring. Practice in simple house wiring and testing methods. Evolution of the neutral in the distribution net work. Soldering of wires. Switch gear used on domestic installation and DB system. Electric shocks and treatment.

WELDING SHOP:

Soldering, brazing. Electric and gas welding.

FOUNDRY SHOP:

Elementary practice for making molds.

DRAFTING:

Practice: Based on the above course work and facilities available.

Recommended books**Text Book**

1. Elements of workshop technology (Vol-II), Machine Tools by S.K. Hajra Choudhury.

Reference Books

1. Principles of Manufacturing Materials and processing by James S. Campbell.
2. Metal work technology and practice by Oswald A. Ludwing.

INTRODUCTION TO MINING ENGINEERING

An introduction to the field of mining engineering and its economic importance, brief review and production of minerals in Pakistan.

Prospecting and exploration, Development and exploitation, Drilling and boring, Explosive and blasting, Mine supports, Material handling, Mine Ventilation, Mine water and its disposal, Importance of safety aspects in mining, Mineral beneficiation, Mine sampling and valuation.

PRACTICALS

Based on the above course work and facilities available.

Reports based on field trips.

Recommended Books**Text Books**

1. Elements of Mining, by R.S. Lewis, John Wiley and Sons.
2. Introductory Mining Engineering by H.L. Hartman. John Wiley and Sons.

Reference Book

1. SME/AIME Mining Engineering Handbook vol. I and II,
2. Directory of Mineral Deposits of Pakistan.

ISLAMIAT AND PAKISTAN STUDIES

As prescribed by the Government of Pakistan.

DIFFERENTIAL EQUATIONS AND FOURIER SERIES

FOURIER SERIES AND INTEGRALS

Periodic function, expansion of functions in Fourier series, Function with arbitrary period, Even and odd functions, Half range expansions, Forced oscillations, Approximation by trigonometric polynomials, The Fourier integrals

LAP LACE TRANSFORM

Lap lace transform of some elementary functions. Lap lace transform theorems, inverse lap lace transforms and methods of finding inverse transforms, applications to solution of ordinary differential equations.

TEXT BOOKS

- 1 Advanced Engineering Mathematics by Erwin Kreyinc John Wiley.
- 2 Engineering Mathematics by S.A.H Rizvi (Vol I and II)

FLUID MECHANICS

Physical Properties of Fluids:

Density, specific weight, specific volume, specific gravity surface tension and compressibility.

Viscosity:

Newton's equation of viscosity, units of viscosity, measurement of viscosity, dissipation of energy in lubricated bearings.

Fluid Statics:

Pressure, pressure-specific weight-height relationship

Unite of Pressure:

Absolute and gauge pressure.

Measurement of Pressure:

Bourden Gauge, manometers and differential manometers. Forces on submerged plane and curved surface and their application.

Flow types:

Basic concepts about steady and unsteady flow. Laminar and turbulent flow. Uniform and non-uniform flow. Path lines, streamlines and stream tubes. Velocity and discharge. Equation of continuity. Impulse-momentum Equation.

Flow Measurements:

Measurements of velocity, pitot tube, measurement of discharge, venturimeter, orifices, notches and weirs.

Steady Flow through Pipes:

Darcy Weisbach equation for flow in pipes, Chezy's Manning and Kutter's formula. Losses in pipe-lines, hydraulic and energy gradients, transmission of energy through pipes. Uniform flow through open channels. (Chezy's and Manning's formula) Economical cross-section; rectangular and trapezoidal. Use of pumps and their characteristics.

PRACTICALS:

Based on the above course work and facilities available.

Recommended Books:

Text Books

1. Fluid Mechanics with Engineering Application by R.L. Daugherty, J.B. Franzini and E.J. Finnemore. McGraw Hill.
2. Hydraulics and Hydraulic Machinery by E.H. Lewitt, Pitman and Sons.

Reference Books:

1. Mechanics of Fluids by A.C. Shaw and D.A. Jobsnon. Longman.
2. Fluid power with application by Anthony Esposito
3. Introduction to Fluid Mechanics by R.W. Fox and Allan T. McDonald. John Wiley and Sons.

INDUSTRIAL MINERALS OF PAKISTAN

Introduction to Industrial minerals and brief geology, types of deposits, occurrences, exploration, mining, beneficiation, utilization and marketing of the following minerals:

Lime stone, silica sand, dolomite, magnesite, phosphate, barite, China clay, other clays, building stones: marble, limestone, granite, quartz, slate, sandstone, soap stone, gypsum, evaporates, asbestos, fluorite and feldspar.

PRACTICALS

1. Preparation of charts and flow sheets.
2. Industrial sample collections and their studies.
3. Visits to mining sites.

Recommended Books:

Text Books

1. Chemistry of Cement and Concrete F.M Lea.
2. Economic Mineral Deposits – A.M. But
3. Mineral Directory of Pakistan – GSP Quetta.
4. Material of construction by Z.H. Syed.

STRUCTURAL GEOLOGY

Introduction to structural geology and its objectives, primary and secondary structures of igneous, sedimentary; and metamorphic; determination of dip, strike and thickness of beds; projection of out crops and construction of cross sections.

Modes of deformation of rocks, parts, varieties and classification of folds, faults, joints and unconformities, expression of the above features on geological field maps. Geological mapping and the application of photogrammetry.

Principles of stratigraphy, concept of geological time and its scale, correlation techniques, Introduction to Stratigraphy of Pakistan.
Applications of stereographic projections.

PRACTICALS

As mentioned in the manual of Structure Geology by A.K. Ghauri.

Recommended books:

Text Books

1. Structure Geology by M.P. Billing. Prentice Hall India.

2. Manual of Structure Geology by A.K. Ghauri (Practical Note Book, National Centre of Excellence in Geology, University of Peshawar (Publisher).

Reference Books:

1. Structure Geology by de Sitter. McGraw Hill
2. Petroleum Geology by F.K. North. Uniwin Hyman Boston (Publisher).
3. Structural Geology of rocks and regions by G.H. Davis. John Wiley and Sons.
4. Structural Analysis of metamorphic techniques by F.J. tuner and L.E. Weiss McGraw Hill.

MINE SURVYING-I

Definition and units of measurements, Essential features of major surveying instruments, Computation, Sources and kind of errors.

LINEAR MEASUREMENTS

Methods of measurements of distance.

LEVELLING

Different Methods and types, Instruments used for leveling.

TRAVERSE WITH COMPASS

Chain traversing, Surface and Underground compass Traversing.

PLANE TABLE SURVEYING

Two points and three point problems

TOPOGRAHIC MAPS

Presentation of relief contours and contour lines, Contour interval and contour map construction and design.

CALCULATION OF AREAS AND VOLUMES

THEODOLITE

Instruments and equipments, contouring, underground traversing, Stop surveying, Transferring meridian, Problems in mine surveying, Triangulation for mine properties.

TUNNEL SURVEYING

Compass survey, Borehole survey, coal mine surveying, Ma0s and sections, Geological maps, Legal requirements of maps and planes, lying out of curves on surface and underground.

TEXT BOOKS

1. Introduction to Mine surveying by Stanly
2. Surveying by Davis and Foot.
3. Surveying and leveling by Kanetker Vol 1 and 2.

Practical and Field work

Practical based on the above course work, including Field Survey Camp.

COMPUTER SCIENCE AND NUMERICAL ANALYSIS

Introduction to computer set up, basic principles of digital computer programming programme structure and flow charts, introduction to machine codes and compilers, introduction to FORTRAN language, methods for analysis of simple elementary problems and preparation of computer programmes, a review of basic FORTRAN concepts and exercises.

Introduction to Numerical Analysis. Finite difference operators and tables, differences of polynomials.

Newton's and Gauss's interpolating techniques for equally spaced data, simple theorems on divided difference, Newton's for unequal intervals, Lagrange's formula of interpolation.

Numerical differentiation & numerical integration, difference equation, numerical solution of system of linear equations, numerical solution of ordinary differential equations: Runge-Kutta method and Picard's method.

PRACTICALS:

Based on the above course work and facilities available.

Recommended books:

1. Teach Yourself C by Herbert Schildt. Osborne. McGraw-Hill.

STRENGTH OF MATERIALS

SIMPLE STRESS

Kinds of stress and strains, Load extension diagram for materials, Hook's law, Moduli of elasticity, Lateral strain, Volumetric strain, Poison's ratio, Temperature stresses and compound bars.

Advanced cases of shear force and bending moment diagrams for statically determinate beams. Relationship between load shear force and bending.

STRESSES IN BEAMS

Theory of simple bending: position of neutral axis, moment of resistance and section modulus, design of homogeneous and non-homogeneous monosymmetric beams, shear stresses in monosymmetric beams.

DEFLECTION OF BEAMS

Double integration, moment area and conjugate beam methods.

COLUMNS AND STRUTS

Short eccentrically loaded columns, Core of a section. Long axially loaded columns; Euler's treatment. Rankine Gordon formula for intermediate columns. Slenderness ratio.

Theory of torsion of solid and hollow circular shafts.

STRAIN ENERGY

Strain energy due to direct load, shear force, bending moment and torque. Stresses due to impact loads.

Note: ***Emphasis should be given on the ability of problem solving and application of mathematical techniques to engineering problems.***

Recommended books.

1. Strength of Materials (4th Edition) by Andrew Pytel and Ferdinand L. Singer.
2. Mechanics of Solids and strength of materials by F.R., Warnock and P.P. Benham.

ENGINEERING STATISTICS.

Definition and scope of statistics. Measure of central tendency. Basic probability theory. Random variable of discrete and continuous type. Probability density function. Distribution function condition probability mathematical explanation. Binomial, Poisson and distribution.

Regression and correlation analysis. Confidence limit.

MINE-SURVEY-II/FIELD SURVEY

Theory and field survey during the semester/term.

Note-Two week survey camp at field site is an integral part of mine survey/field survey course.

COMMUNICATION SKILLS

Mode of communications. Individual and team communications, Modern techniques of communications. Conversation and listening, oral presentations, preparation of technical presentations on data show, Meeting agenda and minutes, Technical report writing and study of English to enable the student to express his idea verbally and in writing.

BASIC METALLURGY

FUNDAMENTALS OF METALLURGY:

Classification of metals, atomic structures, and chemical bonding, crystal structure and X-Ray diffraction.

EXTRACTION PROCESSES:

Survey of extraction processes. The general principle of hydrometallurgy, thermodynamics of hydrometallurgy, roasting, sintering, reduction smelting, and oxidation, chlorination and smelting processes, structures and properties.

IRON AND STEEL PRODUCTING METHODS:

Iron ores and preliminary treatment of iron ores. The blast furnace and its chemistry. Steel making processes, Bessemer converter, open hearth and electric processes.

EXTRACTION PROCESSES OF NON FERROUS METALS:

Ores, Preliminary treatment and extraction procedure of common non-ferrous metals including aluminum, copper, zinc, gold, lead, uranium, and silver. Properties of metals, uses of different metals in different industries, alloys of different metals and their uses.

INTRODUCTION TO PHASE DIAGRAMS AND MICROSTRUCTURES OF METALS.

LABORATORY EXERCISE

1. Identification of some common metallic ores available in Pakistan.
2. Metallography, Micrography and optical microscopy
3. Hardness and tensile tests of metals.

Recommended Books:

Text books:

1. Metallurgy by J. Newton. John Wiley and sons
2. Extractive metallurgy by J.D. Gilchrist. Pergamon Press
3. Metallurgy for Engineers by Rollason, E.C. Edwards Arnolds Publishers.

Reference Books:

1. Elements of Metallurgy by Swarp and Sucsena
2. Testing of metals by Fazal Karim. Feron Sons (Pvt) Ltd. Lahore
3. Principles of extractive metallurgy by Rosenqvist. McGraw hill.
4. Introduction to Physical Metallurgy by Avner.

ROCK MECHANICS

Concept of stress and strain, elasticity, rock and rock mass. Index, physical and mechanical properties of rock. Rock strength stiffness and rock failure theories. Time-dependent properties of rock.

Effect of water, temperature, and confining pressure on rock properties. Static and dynamics methods of rock testing in the laboratory

In-situ stress, underground measurement of stress and strain. Design of single and multiple openings in competent rocks. Design in jointed rock

External and internal modes of ground support. Rock mass classification systems

Practicals based on the theory covered in the class.

Recommended Books:

Text Books

1. Introduction to Rock Mechanics by Goodman
2. Introduction to Rock Mechanics by Obert and Duvall.

Reference Books:

1. Introduction to Rock Mechanics by I.W. Farmer.
2. Rock mechanics for underground Engg. by Brady and Brown.

MINE, POWER, DRAINAGE AND MATERIAL HANDLING

Power:

Various sources of power available at mine, Compressed air power, compressor operation and compressed air theory, Compressed air system design, Electric power, Selection of power cables, power factor. Correction. Load flow analysis and power cost.

Drainage:

Different types of pumps, their characteristics and applications to varied conditions, Calculation of power requirements. Mine pumping system analysis.

Material Handling:

Belt Conveyors: General applications of belt conveyors, Design considerations, material characteristics, belt capacity, width, speed and idler selection, Belt tension and power calculations.

Haulage:

Application of different surface and underground methods of haulage and the equipment used, Locomotive active-effort and duty cycle calculations, power requirement calculations.

Hoisting:

Hoisting equipments, basic hoisting system's and their special applications to different mine conditions, Hoisting calculations, steel rope design and selection

TEXT BOOKS.

1. Mine Machinery by Bryson.
2. Hoisting by Ramlu.

Reference Books.

1. Automatic control engineering by F.H. Raven, Addison Wesley publishing.
2. SME Mining Engineering Handbook (Vols 1 and II) AIME.

MINE VENTILATION

INTRODUCTION:

Objectives of Mine ventilation, Air conditioning and control process, Gas Laws.

QUALITY CONTROL

Mine Gasses:

Nature of air, types, sources, properties and control of Mine Gases, Determination of dilution requirements.

Mine Dusts:

Types, Sources, properties, effects and control, Air borne dust.

Air Flows:

Air flow in dusts and Air ways. Nature of fluid flow, energy changes in fluid flow, Bernoulli's equation head losses, and Mine heads, Atkinson's Equation, Air Power.

AIR MEASUREMENTS:

Temperature, Atmospheric pressure, Air density and air velocity.

VENTILATION SURVEY:

Mine Resistances, series flow, parallel flow, natural splitting controlled splitting, Iterative Techniques.

ECONOMICS OF AIR FLOW:

The basics of economic design, effect of air way characteristics on power consumption, design of air ways.

NATURAL VETILATION:

Pressure source, characteristics, direction of intensity determination.

MECHANICAL VENTILATION:

Classification of mechanical ventilation devices, network analysis by computer, theory and design of fans, fan characteristics, fan laws, different types of fans.

AUXILIARY VENTILATION:

Importance and methods of auxiliary ventilation, Equipments used for centrised electronic Monitoring mine atmosphere.

HEAT AND HUMIDITY:

Sources of heat in mines, physiological effects of heat and humidity, work capacity and efficiency.

PRACTICALS

1. Determination of air velocity, dry bulb temperature wet bulb term.
2. Calculation of velocity head, static head, and total head with the help of pitot tube.
3. Determination of head losses
4. Study of laminar flow, turbulent flow and Reynolds number.

Text Books:

1. Mine Ventilation by Hartman

Reference Books:

1. Mine Ventilation by Hartman,
2. Mine Ventilation by Pennman
3. Mine Environmental Engineering by H. Rabia.

MINERALOGY AND PETROLOGY**Crystallography:**

Elementary introduction.

Mineralogy:

Study of physical, chemical and optical properties of minerals, Classification of minerals and study of common rock forming, ore forming and industrial minerals, identification of minerals with the help of their physical properties.

Petrology:

The nature, composition and classification of igneous, sedimentary and metamorphic rocks. Megascopic and microscopic study of common igneous, sedimentary and metamorphic rocks.

Practicals:

1. Identification of rocks
2. Identification of thin sections
3. Microscopic identification of minerals rocks

Recommended Books:**Text Books:**

1. Dana's elements of Mineralogy
2. Rutleys Manual of Mineralogy
3. Petrology by Alfred Harker. Cambridge University Press.

Reference Books:

1. Geology for Engineers by Blyth
2. Petrology by Tagertts.

COAL TECHNOLOGY

Geology of coal, Coal Classification, Ground control, Room and Pillar method, Long and Short wall mining, Haulage system, Surface mining and Coal utilization.

Text Books

1. Coal Mining Technology by Robert Stefanco
2. Low oil coal technology.

Reference Books.

1. Coal Mining by Mason
2. Introduction to Mining Engineering by Hartman.
3. Coal Mining by Sinclair.

UNDERGROUND HARD ROCK MINE DESIGN

Description and classification of stopping methods in hard rock mining. Selection of mining_methods, Design of mine layout & mode of development, Design of panel layout, mode of location and sequence of recovery; Selection of equipment and machinery, Underground mining practices used in metaliferrous and non-metaliferrous mines of Pakistan.

PRACTICALS

Based on the above course work and facilities available

Text Books.

- 1 Introductory Mining Engineering by H L Hartman, John and Sons.
- 2 Element of Mining Engineering by Lewis and Clark. AIME Publisher.

Reference Books:

- 1 SME Mining Engineering Handbook by .A.B.Cummins. AIME Publishers.
- 2 Underground Mining Methods Hand book, by Hustrulid, AIME Publication.

MINERAL EXPLORATION

Gathering and presentation of geological data, Exploration geophysics and geochemistry, sampling methods including core drilling. Reserve estimation by classical methods. Geo statistical ore reserve estimation. Introduction to processes of formation of mineral deposits.

Text Books

- 1 Mineral Exploration by Kearry.
- 2 Mining Geology by Petens.
- 3 Mining Geology by Mc Kinstry.
- 4 Petroleum Geology by F.K. North.

Reference Books

- 1 Exploration and Mining Geology by W.C.Peters.
- 2 Geology of Petroleum by Levenson.

PRINCIPLES OF EXPLOSIVE ENGINEERING

Explosives history and development, ingredients and chemistry of explosive.

Explosion, properties, classification and characteristics of commercial explosives and blasting agents.

Initiation systems; Rock breakage theories; Principles of priming and loading, Fundamentals of surface and underground blast designs, controlled blasting techniques; Ground vibrations and air blast, safety in explosive handling and blasting.

Introduction to commercial explosives of Pakistan

Recommended Books:

Text books

1. Applied Engineering Technology by Stigolofson
2. Blaster Handbook by E.I. Dupont

Reference Books:

1. Blasting operation by Gary B. Hemphill, McGraw Hill
2. Swedish Blasting Technique by Rune Gustafsson. Published by SPI, Gothenburg, Sweden.

DRILLING TECHNOLOGY

Rock Drilling:

Drilling Methods, classification of methods, Basic system of drilling rig. Field of application. Mining purposes.

Mining Drills. Rotary type Drills; wagon, crawler, drifter surface rigs, coal drills. Introduction, classification, properties of drilling fluids and muds.

Oil Well Drilling:

One-shore, and Off shore drilling, Oil Well drilling machinery, Rig components and their functions of rotary drilling, Types of drilling fluids, fishing, causes of fishing, fishing tools, procedures, directional drilling, diamond drilling, Blow out, kick, and its causes, killing procedures, prevention of blow out, blow out control equipments drill cost calculations.

Casing and cementing oil wells, bore hole logging to deduce litho logy, porosity and formation fluids. Sampling and coring, factors affecting the penetration rate. Planning and computations of drilling project.

PRACTICALS:

- 1 To measure the viscosity, gel strength, gel strength and ph of mud.
- 2 Study of rotary drilling rig.
- 3 Study of cable tool percussion rig.
- 4 Study of wire line core barrel
- 5 Study of various types of bits.

Recommended books:

- 1 Drilling Technology by C.P. Chugh Chilingarian Vorabutr Publisher..
- 2 OGTI Notes.

- 3 High Technology in Drilling and Exploration by C.P. Chugh, Chilingarian Vorabutr Publisher.
- 4 Blow out prevention by W.C. Goins, Jr. (Vol.1), Gulf Publishing company.
- 5 Drilling and Drilling Technology Fluids by G.U. Chilingarain and R. Varabutor. Elsevier Publisher.

MINE ECONOMICS

Introduction: Mining as a Unique Investment Environment

Ore Reserve Estimation

Sampling Methods, Reserve/Sampling Calculations.

Feasibility Studies and Project Financing

Contents of a Mining Project Feasibility Study, Mining Project Financing, Financial Objectives of a Mining Company, Stages and Sources of Financing, Project Planning and Financing Decision.

Financial/Cash Flow Analysis

Time Value of Money, Interest Formulas, Investment Criteria, Net Present Value, Internal Rate of Return, Wealth Growth Rate, Payback k Period, Equivalent Annual Cost, Mutually Exclusive and Non-Mutually Exclusive Project Analysis, Escalation and Inflation Considerations, Uncertainty and Risk Analysis, Depreciation, Depletion, Amortization

Text Books:

1. Examination and Evaluation of Mineral Property, By Park
2. Economic Evaluation and Investment Decision Methods (9th Edition), By Franklin and John Stermole

Reference Books:

1. SME Mining Engineering Handbook (2nd Edition), By Franklin and John Stermole
2. Surface Mining (2nd Edition), Vol.1, By Howard L.Hartman (Senior Editor)

STRATA CONTROL

COMMON GROUND PROBLEMS IN COAL MINES

Types of Failures in Underground Openings, their Classification, Detection, Prediction and methods of Prevention.

GROUND CONTROL PROBLEMS ASSOCIATES WITH LONG WALL MINING

Factors Affecting Panel Layout, Immediate Roof, Main Roof and Sequence of Overburden Movement in Along Wall Panel. Abutment Pressures. Problems Associated with Long wall Mining. Design of Face Support Props. Classification of Powered Supports, their Performance and Design Guidelines, Advantages and Disadvantages. Applicability of Powered Supports. Design of the Cycle of Face Advance. Design of Rib Pillars.

DESIGN OF GALLERY SUPPORTS

Design of Wooden Gallery Sets. Design of Rigid Arches. Design of Articulated Aches. Designs Yield Arches.

STOWING

Importance of Stowing. Application of Stowing Systems. Design of Hydraulic Stowing.

GROUND CONTROL IN MULTIPLE SEAM MINING

Types of Interactions, Major Parameters Controlling Interaction Effects, Parameters Controlling Pillar Load Transferring Mechanism. Design Guidelines and Optimum Mining Plans.

SUBIDENCE & ROCK BURSTS/BUMPS

Theories, causes and remedies of subsidence and rock bursts/bumps, roof and ground control.

PRACTICALS

Based on the above course work and facilities available.

TEXT BOOKS

1. Coal Mine Ground by S. Peng.
2. Strata Control in Mining Engineering by Z.T. Bieniawski.
3. Long wall Mining by S.Peng and Chugh

REFERENCE BOOKS

1. Rock Mechanics for underground Mining by B.H.G. Brady and E.T. Brown.
2. Practical Handbook for underground Rock Mechanics by T.R. Stacy.
3. Subsidence Occurrence, Prediction and Control by Whittiker B.N. and Raddish D.J.
4. comprehensive Rock Mechanics by Hudson.
5. Subsidence in Coal Mines by Synclaire

MINE RESCUE AND SAFETY

Mine Dust and Gases:

Source types, properties, effects, detection, analysis and precautions. Introduction to instruments used for detection and analysis.

Mine Fires Types:

Causes, effects and prevention of underground fires, fire fighting equipment and organization mine explosions, ignition of fire damp, explosion of fire damp, coal dust explosions, stone dust barriers, mixed explosion, explosions in compressed air pipes, investigation of explosions.

Mine Rescue:

Construction, types and uses of various kinds of mine rescue and breathing apparatuses, organization of recovery and rescue work opening of sealed areas, mine, diseases, their treatment and preventions.

PRACTICALS

Based on the above course work and facilities available.

Recommended Books:

Text Books

1. Mine Rescue and Gas detection
2. A Manual on Mine Rescue, safety and Gas detection by J. Strang and P. M Wood

Reference Books

1. Industrial accident prevention by Hein rich
2. Loss control Management by Bird
3. Safety at Work by John Riley

4. Accident Investigations by Jeffery, W. Vincoli
5. Safety Notes of Cornwall School of Mines

FIRST AID

Ten lectures of two hours will be given by an authorized medical practitioner on first aid based on the manual *'Manual First Aid to the Injured'* by Saint Jan Ambulance Association and British Red Cross Society. A certificate will be issued to the student accordingly.

EXCAVATION ENGINEERING

Introduction:

To driving of drifts, x-cuts, raises, winzes etc. Introduction to machine used in tunnel lining, Road header, Tunnel borings machines (TBMs), sequencing of physical operations.

Tunneling:

Historical development and the need for a tunnel in mining various types of tunnels, their shapes and design. Geological aspects of structure site investigation and influence on design and construction of work. Drive-age of tunneling in hard and soft rocks, Control of water, ventilation and illumination, ground stability and tunnel supports

Shaft Sinking:

Shapes, sizes, designs and uses of various types of shafts, selection of shafts and locating sites, shaft sinking techniques for hard rocks, soft ground and other geological unstable areas. Control of water, ventilation and illumination problem, ground stability. Sequencing of physical operations.

PRACTICALS

Based on the above course work and facilities available.

Recommended Books:

Text Books

1. Tunneling in Rock by Ernest E. Wahlstrom. Elsevier Scientific Publishing Company.
2. Element of Mining by Lewis and Clark.

Reference Book:

1. Mining Engineering Handbook by Peerl (Vol.s I and II)

MINERAL PROCESSING-I

INTRODUCTION:

Economic justification and scope of mineral processing, Metallic ores, line flow sheets, efficiency of mineral processing operation, liberation and concentration.

COMMUNITON:

Definition and objectives crushing theory and types of crushing, grinding, types of grinding mills, grinding circuits.

LABORATORY SIZING AND INDUSTRIAL SCREENING:

Laboratory sizing, wet and dry sieve analysis, size distribution, sub-sieve techniques, movement of solid in fluids, stokes law, industrial screening, performance of screens, screens types, screening surfaces.

CLASSIFICATION:

Principles of classification, free and hindered setting, stocks law, hydraulic and mechanical classifiers. Principles of aero and hydraulic cyclones.

GRAVITY CONCENTRATION

Principles of gravity concentration, gravity separators, jigging, Humphrey's spirals, flowing flow concentration, tabling, concentration ratio, grade recovery relationship; heavy media separation (H.M.S).

METALLURGICAL ACCOUNTING AND CONTROL

Sampling and weighing the ore, moisture and assay sampling, on stream analysis automatic control in mineral processing.

Practicals:

Experiments will be conducted from the above course work.

Recommended Books:

Text Books

1. Mineral Processing Technology by B.A. Wills.
2. Ore Processing by Jain, S.K. A.A. Balkema Publishers

Reference Books

1. Mineral Processing by Spoitiswoods and Kelly
2. SME Mineral Processing Hand books

MINE MANAGEMENT

General Definitions

Management, Management Responsibilities, Management Tasks, Project Life Cycle, Tradeoff.

Mine Organization

Types of Organizations, Line / Project Organization, Functional Organization, Matrix and Mixed Organization, the Quality Organization, Organizational Change.

Mine / Project Manager

Types of Manager, Role and responsibilities of Manager, Characteristics of an Effective Team.

Production and Operations Management

Project Planning and control, Projects and Management, Network Analysis, PERT (Project Evaluation and Review Technique), CPM (Critical Path Method), Gantt Charts, Strategic Planning, Decision Making, Mathematical Models in decision Making, Linear Programming, Inventory Control.

Human Resource Management

Recruiting and Selection, Compensation, Training and Development, Performance Measurement, Communication, Union-Management Relations, Reserve/Sampling calculations

Human and Sales Management

Planning, Strategy and Research, Role of a Company in the Market, Leader, Follower, Challenger, Product, Distribution, Promotion, Pricing.

Budgeting

Budgets and Controls, Budgeting Methods.

Effective Communication

The Communication Process, Establishing Communication, Presentations, Communication at Meetings.

Text Books:

1. Project Management
By J.R.Meredith & S.J.Mantel
2. Economic Evaluation and Investment Decision Methods (9TH Edition) By Franklin and John Stermole
3. Engineering Management
By Fraidoon Mazda

Reference Books:

1. SME Mining Engineering Handbook (2nd edition, Vol. 1)
By Howard L.Hartman (Senior Editor)
2. Surface Mining (2nd Edition)
By B.A. Kennedy

SURFACE HARD ROCK MINE DESIGN**Surface Mine development**

Pit Planning and Design, Long range Planning, Short Range Planning, Equipment Selection, Cutoff Grade, Stripping Ratio, and Pit Limits,

Surface Mining Methods (General description, sequence of development, cycle of operations, conditions and features)

Open Pit Mining (Metals & Industrial Minerals), Open Cast Mining (Coal), Quarrying (dimension stone/industrial mineral mining), Aqueous Extraction Methods, Placer Mining, Dredging, Hydrauliclicking, Solution Mining, Borehole Extraction, Leaching.

Pit geometric Considerations

Basic Bench Geometry, Ore Access, Pit Expansion Process, Pit Slope Geometry, Final Pit Slope Angles, Geo mechanical Background, Slope failure, Modes, Slope Stability Analysis, Adding a Haul Road, Design of Spiral Road – Inside the Wall, Design of Spiral road – Outside the Wall, Design of a Switchback, Volume Representation by a Road, Haul Road Construction, Road Section design, Straight Segment Design, Curve Design, Berm Design, Hal Road Gradients.

Surface Mining Equipment (Typical units, general characteristics, basic machine operations, applications, selection considerations)

Excavating/loading Equipment, Hydraulic Shovel, Electric Shovel, Bucket Wheel Excavator, Front-End-Loader, Dozer, Draglines, Hauling/Transportation, equipment, Trucks, Belt Conveyors.

Surface Mine Waste Disposal

Dump Design, Stability of Mines Waste Dumps, Ground Water and Contamination.

Mine Reclamation

Reclamation Planning, Reclamation Unit Operations.

Surface Mining Practices in Pakistan

Laboratory Work: Based on above course outline and surface mining visits

Text Books:

1. Introductory Mining Engineering
By Howard L. Hartman
2. Slope Stability
By M.G.Anderson & K. S. Richards

Reference Books:

1. Surface Mining (2nd Edition)
By B.A. Kennedy (publisher by SME)
2. Open Pit Mine Planning and Design
By W.Huustrulid and M. Kuchta (Publisher by A.A. Blakema)
3. Mining Engineering handbook (AIME Publisher)
4. Quarrying, Open cast Mining and Alluvial Mining
By John Sinclair
5. Rock Slope Engineering
6. By Hoek and Bray

MINING LAW

The Mines Act, 1923, The Consolidate Mines Rules, 1952, The Coal Board Rules, 1951, The Coal Mines Regulations, 1926, The Metaliferous Mines Regulation, 1926, The Coal Mines Pithead Bath Rules, 1946. An introduction to the following: The workman's compensation Act, Industrial Relations Ordinance The Payment of Wages Act. Industrial and Commercial Employment, (Standing Orders) Ordinance, E.O.B.I. Act/Rules, Mining Concession Rules, Explosive Rules.

Recommended Books

1. Mining Labour code by M.A. Shafi
2. Critical case studies of important court verdicts regarding mining.

3. Mineral concession rules by Abid
4. Industrial and commercial employment ordinance 19....
5. Payment and Wages ordinance 19...

MINERAL PROCESSING-II

FLOCCULATION AND DISPERSION:

Electrical double layer theory, flocculation, coagulation and dispersion phenomena, mechanism and application. Introduction to the surface chemistry of minerals.

FLOTATION:

Flotation, chemical and physical aspects, process, uses with examples. Flotation reagents, absorption mechanism, classification, types and application, differential flotation of complex ores.

FLOTATION MACHINES:

Flotation machines, pneumatic and mechanical types.

MAGNETIC AND ELECTROSTATIC SEPARATION:

Magnetic electrostatic separation, principles, machines and application.

NON-CONVENTIONAL PROCESSES:

Treatment of minerals by non-conventional processes.

SOLID LIQUID SEPARATION:

Separation of solids from fluid, dewatering, filtration, drying, devices for solids/liquids separation.

AUXILIARY OPERATIONS AND FLOW SHEETS:

Auxiliary operations plant flow sheets and circuit diagrams.

INTRODUCTION TO MILL DESIGN AND ENVIRONMENT:

Mill design, basis of design selection of site and services. Environmental consideration, brief description of environmental protection requirements in respects of solid waste, liquid and liquid borne wastes, gaseous or airborne wastes and noise level control.

COAL PREPARATION:

Introduction to coal cleaning and coal preparation

PRACTICALS:

Based on the above course work and facilities available.

Recommended Books:

Text Books

1. Mineral Processing Technology by B.A. Wills, Pergoman Press
2. Ore processing by Jain, S.K. A.A. Balkema Publisher

Reference Books:

1. Mineral Processing by Spoitwoods and Kelly
2. Flotation by Crozier 1992 Pergamon
3. Mineral Processing Hand Book, 1986 Society of Mining Engr. of AMIMPE Inc New York
4. Industrial Minerals Snnha, R.K Indian book

PROJECT

A maximum of two students can pick any project in the following areas of studies and delineating its application. The project should be approved by the chairman of the department and mutual consultation with a faculty member who will serve as a supervisor.

- a. Mineral Processing*
- b. Explosive and blasting*
- c. Design and fabrication of Mine Machinery and equipment at pilot scale*
- d. Rock mechanics and geo-technical engineering*
- e. Mine safety and rescue*
- f. Surface and underground mining method*
- g. Mineralogy and Petrology.*
- h. Mine Management and Economics*
- i. Geology*

A student has to present his work through two oral presentations during the session and technical expert will evaluate students thesis

ADDITIONAL SUBJECTS

APPLIED PHYSICS

Heat and Light. Heat insulation, thermal properties of earthy materials. Surface reflectivity of an absorption of light by solid materials.

Photometry, plane and polarized light, double refraction.

SOUND:

Propagation of sound wave in solids. Liquids and gases and velocity measurement, noise, levels, and measurements.

ELECTRICITY AND MAGNETISM

Design principles and electromagnet, permanent magnets and materials, magnetic circuits and effect of air gaps on field intensity. Relative permeability and dielectric properties of solids, propagation of electromagnetic waves in materials.

ATOMIC AND NUCLEAR PHYSICS

Piezoelectricity Pyro-electricity, fluorescence and other secondary emissions produced by excitation by X-rays or cathode rays. Radioactivity of materials and their half lives.

INSTRUMENTATION

Geiger counters and scintillations, cathode ray oscilloscopy, gausermeters, X-ray Fluorescence equipment and X-ray Diffraction equipment.

PRACTICALS

Based on the above course work and facilities available.

APPLIED MECHANICS

Uniplaner Force Systems:

Components of a force. Resultant and equilibrium of concurrent and Non-concurrent forces Parallel forces, couples, Center of Gravity.

Farmed Structures:

Analysis of forces in determinate Framed, Graphical solutions, methods of Joints and method of section, friction; Laws of Friction. Machine bearings, Journals, Inclined Planes and screws.

Simple cases of bending Moment and shear force in Beams and cantilevers.

Work, Energy, Power and Machines, Meaning of work energy, power, Efficiency of load lifting machines. Effect of friction. Diagram of work. I.H.P. and B.H.P.

Velocity and Acceleration:

Motion with constant acceleration. Freely falling bodies. Motion with variable acceleration, projectiles. Angular velocity and Acceleration.

Mechanical Vibration:

Simple Harmonic motion. Free vibration Simple pendulum, compound and torsion pendulum.

Inertia:

Moment of Inertia. Kinetic energy of rotation. Momentum, Impulse and centrifugal force. Banking of tracks angular momentum. Gyrostatic action.

Fly Wheels and Governors:

Co-efficient of Fluctuation of speed and energy. Centrifugal tension in Flywheels effects of an arm loaded Governor.

Transmission of Motion by Belts, Ropes and Tooth wheels; Velocity ratio of pulleys Centrifugal tension in ropes and belts. Angular ratio. H.P. Transmitted.

PRACTICAL

1. Determination of Forces in the various parts of a hanging cord.
2. Verification of link polygon method
3. Determination of forces in the roof truss
4. Reactions of Forces beams by graphical method
5. Determination of Forces in the wall crane
6. To draw the load efficiency curve for various load lifting machine
7. Experiment on smooth and rough inclined planes
8. Moment of inertia by falling weight and rolling method
9. Experiments with groystat.
10. Determination of the co-efficient of friction between the belt rope and wheel.

Recommended Books

1. Engineering Mechanics (Vols. 1 and 2), by J.L. Meriam and L.G. Kraige, John Wiley and Sons.

INTRODUCTION TO GEMOLOGY

Geology and exploration of gems, Gem producing countries of world, gem mining and its extraction, Gem storage, its proper identification and preventive measures of pilferage at mining sites, gem cutting and polishing techniques, identification techniques of gems for its quality. Gem pricing and grading according to prevailing international standards, Pakistani gems and its quality, pricing and marketing.

MINE ENVIRONMENTAL ENGINEERING

Introduction, history and importance of environmental problems, concept of pollution, Mining pollutants. Air pollution with respect to Mining and sources.

Air pollution sampling and measuring techniques and control methods.

Water pollution, its concept, nature and effects of water pollutions, control measures.

Heavy pollutions from Mineral based industry

Ecological impact and reclamation of mind land

Environmental impact assessment. Pakistan environmental Act, 1995.

PRACTICALS:

Based on the above course work and facilities available

Recommended Books:

1. Environmental Engineering: in Mine by Volkin V.S. and Lene R.D.

Reference Books:

1. Environmental and Aqueous Chemistry by Moral and Stumm. John Wiley and Sons.
2. Mine Environmental Engineering by H. Rabia.

Detail of Courses for M.E./M.Sc.

Mining Engineering

M.Sc degree is awarded according to the prevailing rules and regulations of the particular University. The following courses are recommended for M.Sc degree programme in Mining Engineering subject to the availability of experts and keeping the view the geographical needs of that area.

MIN-E- ADVANCED MINERAL PROCESSING (3)

Smelter schedule selection of communiton method for specific concentrating process and machines. Development of new methods and equipments for treatment of ores e.g. selective flocculation and flotation, agglomeration, flotation, progress in gravity and magnetic separations. Seminars on selected topics in advanced treatment of ores with reference to Pakistan ores will be given by the students.

Min-E- ADVANCED EXPLOSIVE ENGINEERING (3)

Theory and application of explosives, composition and characteristics of explosive reaction, and effects on materials millisecond delay blasting; various considerations in blast design; Blasting Economics.

MIN-E- COAL PREPRATION (3)

Properties of coal and impurities in relation to preparation; sampling of coal; coal characteristics and their relation ship to utilization, wash ability studies and evaluation of coal for different uses; the economics of coal preparation; raw coal handling, breaking and crushing; screening, wet concentration methods of coarse coal; wet concentration methods of fine coal; dry concentration, mechanical & thermal dewatering, status & scope of coal preparation by flotation. Dust collection in coal processing and handling. Coal storage and loading plant waste and Environmental consideration.

MIN-E- ADVANCED FLOTATION (3)

Phases in flotation, bonding, adsorption at solid liquid interface; electrical properties of surfaces in relation to flotation, classification of flotation reagents and their uses, detailed information for flotation of sulfides, silicates and non polar minerals, state of Art of flotation of Pakistani coal and minerals.

MIN-E- MINERAL ECONOMICS (3)

Roles of minerals in national economy Mineral resources availability. Theory of depletion, National and International rock in minerals stockpiling conservation, cartel price. Investment in minerals sector; opportunity and risk. Mineral Taxation, Mineral market structure, impact of mineral Economics toward metallic and non metallic of Pakistan.

MIN-E- MANAGEMENT FINANCE (3)

Introduction to Role of Management Finance; Decision making and planning Process; control and business objectives.

Measuring and reporting financial position, financial performance and cash flows; Finance for Limited Companies; analysis and interpretation of Financial statements:

Cost- **Volume-Profit Analysis**_ Behavior of costs, Break-even analysis, Margin of safety, Make-or-buy decisions; Full costing.

Budgeting- flexible budging, variances and their investigation; Behavioral aspects of budgetary control.

Capital Investment Decisions- ARR, PP, NPV and IRR and their practical points, Management of working capital and financing the business.

MIN-E- NON-EXPLOSIVE ROCK FRAGMENTATION (3)

Introduction, objective, rock breaking with mechanical tools, Non-conventional rock destruction methods, Hybrid methods of rock cutting.

MIN-E- INFORMATION TECHNOLOGY FOR MANAGERS (3)

Role of Managers in Information Technology.

Technology to Transform the organization; interpreting and understanding information; information Technology in perspective.

Organization Issues

Impact of Information technology on the organization; strategic issues of information technology .

Information Technology.

Fundamentals; software; database management; communications; networks; information technology Architectures.

System Analysis and Design.

Building systems- Creativity and developments; Reengineering; organization support systems; intelligent systems.

MIN-E- DESIGN OF MINERAL PROCESSING PLANTS (3)

Feasibility studies, sampling of a mineral deposits for feasibility studies and metallurgical testing, crushing & grinding with particular reference to Autogenous grinding selection of Screens & Classifiers, Process design and Plant design for gravity concentration, Design of Flotation circuit, Magnetic separation, Heavy Media Separation Flow sheet development, selection of filters and thickness, concentrate drying, Automation of a instrumentation for solid liquid separation, environmental consideration in Mill sitting construction of a Modern Mineral Processing Plant, Design of mineral processing flow sheets, the future of plant design, problems in Mill Processing.

MIN-E- GEOSTATISTICAL ORE RESERVE MODELING(3)

Introduction to application and theory of geostatistics in mining industry, Review of elementary statistics and traditional ore reserve calculation techniques. Presentation of fundamental geo-statistical concepts, including variogram, estimation variance block variance, kriging, geo-statistical simulation, Emphasis on the practical aspects of geo-statistical modeling in mining.

MIN-E- MINE COST ANALYSIS & CONTROL(3)

Cost-Concepts, uses and classification;

Systems-Job order and Process order costing systems.

Mines Overheads-Departmentalization and cost control along with variances analysis.

Materials and Labour- Costs control and the variance analysis.

Budgeting-Master Budget, flexible budgets and cost behavior analysis.

Gross Profit-Analysis and Pricing Decisions.

Break- Even and cost volume-prefect analysis.

Capital Budget-Capital expenditure-planning, evaluating and controlling;

Financial Statements- Evaluating results for outsiders and insiders.

MIN-E- SUBSIDENCE ENGINEERING (3)

Prediction of surface subsidence.

Profile function Method

Influence function method

Graphical Method

Finite element method

Computer models for subsidence prediction
Surface structure damages
 Types of damages
 Criteria for damages
Prevention of surface structural damages
 Mining Layout
 Protective measures for houses pipes highways and bridges
Subsidence Measurement techniques
 Measurement of surface movement
 Measurement of subsurface for movements
Measurement of structural damages.

MIN-E- FINITE ELEMENT ANALYSIS (3)

Introduction and Basic concepts of F.E.M.
Variational Formulation of Boundary Value problem
 Variational Methods
 The Ritz Method
 The method of weighted residuals.
Finite element analysis of one dimensional two dimensional and three dimensional.
 Discretization of domain into elements
 Derivation of element equation
 Assembly of elements
 Imposition of boundary, conditions
 Solution of equations
 Post processing of the solution
Computer Implementation.

MIN-E- EXCAVATION ENGINEERING (3)

Introduction, classifications of underground structures strategies for subsurface investigation and testing, design methods, excavation methods for underground structures.

Design philosophies for tunnels in soils, swelling and squeezing grounds and seismic zone.

Support of underground openings and Rock Reinforcement. Ground water control.

MIN-E- MINE ENVIRONMENTS (3)

The thermodynamic analysis of air flow in mine air ways. Use of computer software for the solution of complex mine networks containing multiple fans, natural ventilation and air cooling/heating units.

Outbursts of gases, methane drainage and layering. Advanced study of health and explosion problems of dusts in mines.
Air conditioning applied in mines.

MINE-E- OPEN PIT MINE PLANNING & DESIGN (3)

Mine planning; ultimate pit definition; open pit optimization; geometrical considerations; production planning & scheduling equipment selection.

MINE-E- MODERN MINE MANAGEMENT(3)

Management and its History, social responsibility and business ethics management in global arena.

Planning- Fundamentals; Decision Making; Strategic Planning, and Planning Tools.

Organizing- Fundamentals; Authority of Delegation; Managing Human resources; managing change and stress.

Influencing- Fundamentals, communication, Leadership, motivating employees, Team working, corporate culture, Human behavior in organizations.

Controlling- Foundations; Production Management and Control, Managing Entrepreneurial ventures and controlling issues.

MINE-E- SURFACE COAL MINING AND EQUIPMENT DESIGN (3)

Advanced methods of designing surface coal mines, optimization of pit geometry, surface coal mining systems for gentle and steep deposits, dragline, bucket wheel excavator, shovels, pit slope design and coal quality control.

MINE-E - ENVIRONMENTAL CONTROL FOR BLASTING (3)

Review of blasting theory controlled blasting techniques, ground vibrations & control, blasting seismograph operation, Geological effect on blasting, Air blast & control fly rock control, blasting security, toxicity & pollution control.

MINE-E- MINE SYSTEMS SIMULATION (3)

Principles and practices of probabilistic and deterministic simulation in the analysis of operating system relating to mines.

Min-E- MINE ADMINISTRATION AND LABOUR RELATIONS (3)

Essentials of management, Decision making, communication, Managerial accounts history of Labour movement world wide. Labour movement in Pakistan, Unions, Strikes, Lockouts, Negotiations, Agreements.

MIN-E- LOSS CONTROL AND SAFETY IN MINING (3)

Mining as a hazardous industry Hazards of mining operations, causes of mine accidents, concept a accident prevention, Basic principles of accident prevention, Safety performance measurement, importance of accident investigation, accident investigation techniques, concept of total loss control, loss control through safety management, cost of accidents, cost analysis of mine accidents.

Min-E- ADVANCED ROCK MECHANICS (3)

Rock pressure theory and theory of failures. Rock bursts, ground control and supports. Mining with high technology equipments, concept of finite methods of design

Min- E- ADVANCED MINE VENTILLATION NETWORKS AND ENVIRONMENT

Thermodynamics analysis of mine air flow, Network analysis of mine resistance, Methane drainage. Ventilation in radio active mines. Instrumentation and controls. Hazardous mine dusts and control, Role of computers in ventilation net works.

Min-E- COMPUTER APPLICATION IN MINING &ADVANCED PROGRAMMING (4)

A history of computers and their applications. Advent in Mining industries Mainframes, Minis and Micros. Programming languages, some advanced programming related to Mining application. Computer aided design of Mine workings.

Min-E- OPERATIONS RESEARCH (3)

Scope of systems engineering production scheduling and planning. Linear programming, simplex methods. Transportation and assignment methods. Critical Path Methods. Management and cost control system.

Min-E- HYDROMETALLURGY (3)

Surface chemistry of mineral particle. Chemistry of flotation and agglomeration. Amalgamation and cyanidation.

Min-E- MINERAL PROCESS DESIGN (3)

Mineralogical approach of the ore and material minerals with respect to process selection. Advanced technique of liberation studies process selection and process testing for reproducing of test results. Economic and technical evaluation of the process selected. Pilot plant testing and statistical feasibility studies. Detailed discussions of standard flow sheets and techniques of designing.

Min-E- ANALYSIS OF DEFORMED GEOLOGICAL STRUCTURES (3)

Principles of Rock deformation, deformation mechanics, primary structure folding foliation, lineation, intensive and extrusive structures, faults and joints, and deformation of lithosphere.

Min-E- UNDERGROUND MINE DESIGN (3)

Pressure Theories. Theoretical and physical modeling methods. Design of Support. Support Characteristics Functional reliability of reinforcement. Subsidence and strata control.

Min-E- ROCK MECHANICS IN MINE DESIGN (3)

Design process in Mining Engineering. Design approach for excavation in Rock. Input parameters for design. Empirical observations and analytical methods of design. Integrated design.

Min-E- ROCK SLOPE ENGINEERING (3)

Designing of Civil and Mining Slopes. Modes of slope failures. Economic and planning considerations. Graphical representation. Probabilistic approach to slope design.

Min-E- PROJECT MANAGEMENT (4)

Introduction: Project Management vs. Leadership, Management Process and Managerial Functions, Project life cycle, Project Manager: Role and Responsibility, qualities of a good manager.

Project initiation (1) Project Evaluation and Selection: Project Selection Models: Criteria, Nature and Types Project Proposal. (2) Project Organization: Project as part of functional organization, pure Project organization, Matrix organization and mixed organization. Choosing and organizational form. (3) Project Planning: Initial Project Coordination, System Integration, System Integration, Elements of Project Plan, Linear Responsibility Chart-Exercise.

Project implementation: (1) Introduction to budgeting; Budgeting Methods, Cost Estimation. (2) Scheduling; Network techniques CPM, PERT and Gantt Chart-Exercise (3) Monitoring and information system. Designing a monitoring system, Data collection, Report Types, Common Reporting problems, Milestone Reporting (4) Project Control; Purpose, physical Assets, Human Resources, and Financial control.

Project Termination: When to terminate a project: Termination by extinction, Termination by inclusion, Termination by integration, project History Report.

Other Aspects of Project Management: (1) Quality Management: Demings' Fourteen principles for continuous improvement, introduction to statistical process control (2) Risk Management- An introduction (3) Conflict Management- An introduction (4) Negotiation Techniques (5) Interviewing as Business Function: Types of Interview.

MIN-E- GEOCHEMISTRY (3)

Structure of the Earth- crust, mantle, core, mass moment of inertia seismic evidence. Temperature and pressure distribution. Isotope Geochemistry: Main Chemical Elements-Relative abundances of some elements and types of compounds. Densities and compositions of different layers. Chemistry of igneous, sedimentary and metamorphic rocks. Structural Aspects- silicate chemistry, bond angles, coordination of ions, ion replacement. Some important series.

Geochemistry of Surface and sub surface water: Effects of water-hydrothermal processes, supercritical water, crystallization. Effect of water on melting points. Thermodynamic- silicate systems, phase changes; three component diagrams, composition of layers in the mantle, at high pressure, Oxidation and Reduction-Composition of atmosphere, changes, the effects on iron and different minerals, Electrical conduction by silicates. Less abundant Elements- Segregation in the crust. Availability of useful elements, formation of ore deposits.

MIN-E-5590 SPECIAL STUDIES (3)

Individual's studies on selected topics.

MASTERS THESIS (6)

Laboratory, field or library work of an investigation for the Master's thesis under supervision of a supervisor.

RECOMMENDATIONS

1. Courses in the draft prepared by the Committee are given in the term system format. However it may be the discretion of the respective university to adopt according to their own regulations that are in vogue.
2. The proposed courses should be made compulsory in all the universities of Pakistan. However, the elective subjects proposed may be included in the curriculum depending upon the availability of expertise and the local needs of the industry.
3. The course "Project" appears in the final term of the programmes draft curriculum. However it is recommended that students may be allotted project in the beginning of the seventh term.
4. The field training for students should be made compulsory as part of fulfillment of their degree programmes.
5. A teacher training programme and refresher courses should be put in place to familiarize the teachers with the modern trends of the technology.
6. Cheap editions of the books for Mining Engineering are not available in the local markets. Therefore, funds should be granted by the HEC to provide all the related books to the students.
7. The use of computer is integrated into most courses, assignments, etc, therefore funds should be made available for sufficient number of PCs.