FIRST YEAR OF BACHELOR'S DEGREE COURSE IN ENGINEERING
(Revised in 2007-08)

SCHEME OF INSTRUCTION AND EXAMINATION

SEMESTER I (Common for all branches of Engineering)

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
1.1	Applied Mathematics I	4	-	-	3	100	25	-	-	125
1.2	Applied Sciences I (Physics & Chemistry)	4	-	2	3	100	50	-	-	150
1.3	Basic Civil Engineering and Engineering Mechanics.	4	-	2	3	100	25	-	-	125
1.4	Basic Electrical Engineering	3	-	2	3	100	25	-	-	125
1.5	Engineering Graphics	2	-	4	4	100	50	-	-	150
1.6	Communication Skills	3	-	-	3	100	25	-	-	125
1.7	Workshop Practice - I	-	-	4	-	-	50	-	-	50
	TOTAL	**20**		**14**		**600**	**250**			**850**

SEMESTER II: (Common for all branches of Engineering)

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
2.1	Applied Mathematics II	4	-	-	3	100	25	-	-	125
2.2	Applied Sciences II (Physics & Chemistry)	4	-	2	3	100	50	-	-	150
2.3	Information Technology	4	-	2	3	100	25	-	-	125
2.4	BasicMechanical Engineering	3	-	2	3	100	25	-	-	125
2.5	Basic Electronic Engineering	3	-	2	3	100	25	-	-	125
2.6	Environmental and Social Sciences	4	-	-	3	100	50	-	-	150
2.7	Workshop Practice II Modern	-	-	4	-	-	50	-	-	50
	TOTAL	**22**		**12**	**-**	**600**	**250**	**-**	**-**	**850**

Second Year B.E (Mining Engg) – Semester III

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
MN.3.1	Engg Mathematics III	3	1	-	3	100	25	-	-	125
MN.3.2	Electrical Drives & Digital Electronics	3	1	2	3	100	25	25	-	150
MN.3.3	Mechanics of Solids	3	-	2	3	100	25	25	-	150
MN.3.4	Elements of Mining Engineering	3	1	-	3	100	25	-	-	125
MN.3.5	Machine Drawing & CAD	1	1	3	1	100	25	25	-	150
MN.3.6	Mining Geology I	3	1	2	3	100	25	25	-	150
	Total	**16**	**5**	**9**		**600**	**150**	**100**	**-**	**850**

Note: Geological Tour/Camp to be held during vacation after III semester, which will be evaluated in Semester IV.

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

Second Year B.E (Mining Engg) – Semester IV

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
MN.4.1	Mine Development	3	1	-	3	100	25	-	-	125
MN.4.2	Fluid Mechanics & Machinery	3	-	2	3	100	25	25	-	150
MN.4.3	Mining Geology II	3	2	-	3	100	25	-	-	125
MN.4.4	Surveying-I	3	-	2	3	100	25	25	-	150
MN.4.5	Rock Mechanics & Ground Control -I	3	1	2	3	100	25	25	-	150
MN.4.6	Numerical Techniques & Statistics	3	1	-	3	100	25	-	-	125
MN.4.7	Geological Tour/Camp*	-	1	-	-	-	25	-	-	25
	Total	**18**	**6**	**6**		**600**	**175**	**75**		**850**

*Geological Tour/Camp to be held during winter vacation after III semester, which will be evaluated in IV semester.

Note: Industrial Training I to undergo during summer vacation after Semester IV examinations.

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

Third Year B.E (Mining Engg) – Semester V

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
MN.5.1	Surveying-II	3	-	2	3	100	25	25	-	150
MN.5.2	Rock Mechanics & Ground Control-II	3	-	2	3	100	25	-	25	150
MN.5.3	Mining Machinery-I	3	-	2	3	100	25	-	25	150
MN.5.4	Mine Management & Legislation	3	1	-	3	100	25	-	-	125
MN.5.5	Surface Mining	3	2	-	3	100	25	-	-	125
MN.5.6	Underground Coal Mining	3	1	-	3	100	25	-	-	125
MN.5.7	Industrial Training I*	-	-	4	-	-	25	-	-	25
	Total	**18**	**04**	**10**		**600**	**175**	**25**	**50**	**850**

* Industrial Training I is to be carried out during summer vacation after Semester IV and the report is prepared in Fifth sem.

Note: A survey camp/project will be organised during the winter vacation after V semester and the project will be prepared in the sixth semester.

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

Second Year B.E (Mining Engg) – Semester VI

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
MN.6.1	Mining Machinery-II	3	2	-	3	100	25	-	-	125
MN.6.2	Mine Environment-I	3	1	2	3	100	25	25	-	150
MN.6.3	Mineral Processing	3	-	2	3	100	25	25	-	150
MN.6.4	Underground Metal Mining	3	1	-	3	100	25	-	-	125
MN.6.5	Mine Economics & Valuation	3	1	-	3	100	25	-	-	125
MN.6.6	Mine Surveying	3	1	-	3	100	25	-	-	125
MN.6.7	Survey Camp/ Project*	-	-	4	-	-	25	-	25	50
	Total	**18**	**06**	**08**		**600**	**175**	**50**	**25**	**850**

* Survey Camp/Project is to be carried out during winter vacation after Semester V examinations, whose evaluation is done in SemesterVI**.**

Note: Industrial Training II is to be carried out during summer vacation after Semester VI examinations and the evaluation is done in Semester VII.

□ Theory combined with Sessional is a single head of passing while P, O are independent head of passing

Final Year –BE (MN) - Semester-VII

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub. Code	Subject	Scheme of Instruction Hrs/week			Scheme of Examination					
		L	T	P	Th. Dur (hrs)	Marks				
						Th	S	P	O	Total
MN.7.1	Mine Environment II	3	1	2	3	100	25	-	25	150
MN.7.2	Mine Disaster Management	3	1	-	3	100	25	-	-	125
MN.7.3	Mine Environmental Management	3	1	2	3	100	25	-	25	150
MN.7.4	Elective-I	3	1	-	3	100	25	-	50	175
MN.7.5	Elective-II	3	1	4	3	100	25	-	50	175
MN.7.6	Project (Interim)	-	-	4	-	-	25	-	50	75
Total		**15**	**5**	**12**	**-**	**500**	**150**	**-**	**200**	**850**

Elective I: MN.7.4.1: Rock Fragmentation Engineering/ MN.7.4.2:Underground Space Technology / MN.7.4.3: PetroleumEngineering

Elective II: MN.7.5.1: Geodetic Surveying / MN.7.5.2: Optimisation Technique in Mineral Industry / MN.7.5.3: Computer Programming (Oops) in C++

Note: Study Tour/ First Aid Course/ Gas testing class is desirable during winter vacation after Semester VII examinations to help students to become eligible for Manager's Competency Certificate by DGMS.

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Final Year –BE (MN) - Semester-VIII

L- Lecture; T – Tutorial; P – Practical; Th. Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub. Code	Subject	Scheme of Instruction Hrs/week			Scheme of Examination					
		L	T	P	Th. Dur (hrs)	Marks				
						Th	S	P	O	Total
MN.8.1	Mine Planning & Design	3	2	-	3	100	25	-	50	175
MN.8.2	Mine Safety & Legislation	3	1	-	3	100	25	-	50	175
MN.8.3	Elective-III	3	2	-	3	100	25	-	50	175
MN.8.4	Elective-IV	3	-	3	3	100	25	-	50	175
MN.8.5	Project (Final)	-	-	8	-	-	50	-	100	150
Total		**12**	**5**	**11**	**-**	**400**	**150**	**-**	**300**	**850**

Elective III: MN.8.3.1: Rock Slope Engineering / MN.8.3.2: Geostatistics/ MN.8.3.3: Small Scale Mining and OceanMining

Elective IV: MN.8.4.1: Entrepreneurship Development / MN.8.4.2: Exploration Geology / MN.8.4.3: Computer Applications in Mining

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

MN.3.1 – ENGINEERING MATHEMATICS III

Course Objective: To equip students with adequate knowledge of mathematics that will enable them in formulating problems and solving problems analytically.

Instructional Objective: The course will enable students in handling linear systems using matrices.Use tools like Laplace transforms, Fourier transforms and Fourier series in formulating and solvingproblems.

TeachingScheme:
Lecture:3Hrs/week
Tutorials:1Hr/week

ExaminationScheme:
Theory: 100marks
Sessional : 25 marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn fromeach module for term end theory examination. Total five questions to be answered takingminimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Matrices: types, determinant, inverse, elementary transformations, rank, reduction to normal, canonical forms, linear independence of vectors, system of the form A.X=O and A.X=B and their solutions, Eigen values and vectors, Cayley-Hamilton theorem with applications, minimal polynomial and diagonalization

Module2

Fourier Series: periodic function, trigonometric series, Euler‟s formulae, Drichlet‟scondition,Even and odd functions, half range series, Parseval‟sidentity.
Fourier transformations: Fourier transform, inverse Fourier transforms, applications, convolution theorem

Module 3

Laplace Transforms: definition, existence conditions, properties, inverse Laplace transforms, transform of periodic functions and Dirac-Delta function, convolution theorem, applications insolving linear differential equations with initial conditions and system of linear simultaneousequations

Module 4

Partial differential equations: classification, solution by method of separation of variables
Wave equation: derivation and solution of one-dimensional wave equation using separation variables method

Heat equation: derivation and solution of one-and two dimensional using separation variablesmethod

TEXT BOOKS:

1. Grewal, B. S., Higher Engineering Mathematics, Khanna Publications, NewDelhi
2. Veerarajan, Engineering Mathematics, Tata-McGraw Hill publications, NewDelhi.
3. Erwin Kreyzig, Advanced Engineering mathematics, New International PubLtd

REFERENCE BOOKS

1. Kandasamy, P., Engineering mathematics, Chand & Co. NewDelhi
2. . Baphana, R. M., Applied mathematics III, TechnovaPublication.
3. Andrews.L.A.,Shivamoggi.B.K., Integral Transforms for Engineers and Applied Mathematicians, Macmillen, New York, 1988.
4. Narayanan.S.,M.Pillai, Advanced Mathematics for Engineering Students Vol. II &III,Viswanathan Publishers, Chennai,2002.
5. Churchill.R.V.,Brown.J.W., Fourier Series and Boundary Value Problems, $th Edition, McGraw Hill Book Co. Singapore, 1987.
6. Wylie.C.Ray, Barrett Louis.C., Advanced Engineering Mathematics, 6th Edition, McGraw Hill Inc. New York,1995.

MN.3.2 – ELECTRICAL DRIVES & DIGITAL ELECTRONICS

Course Objective: Electrical drives are the prime movers for mining machinery and they are controlled through digital electronic circuit. The course aims to provide concepts of electrical driveswith associated controls.

Instructional Objective: The course equips the students with basic knowledge on electrical motors, use of instruments for electrical measurements and how an electronic circuit works.

Teaching Scheme:
Lecture:3Hrs/week
Tutorial:1Hr/week
Practicals:2Hr/week

Examination Scheme:
Theory: 100Marks
Sessional: 25 Marks
Practical: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

D.C. Motors: Principles of electromechanical energy conversion. DC machine: construction, EMFequation. D.C motors: principles, torque equations, motor characteristics, speed control, starting.Three phase induction motor- principle, construction, slip, torque-slip characteristics, starting, speedcontrol.

Module 2

Single phase induction motor: Principle operation of split phase type, capacity start motors, stepper motors-types, principle; Synchros -construction, principle andapplications; servo-motorsDC, 2-phase AC; drives concept, classification, characteristics and braking of DCmotors

Module 3

Instruments: Working principle, construction, torque equations of the following analog instruments: (a) PMMC (b) Moving iron (c) Electrodynamometer types, Shunts and multipliers for PMMC type instruments and extension of range. Electrodynamometer. Wattmeter: construction,torque equation. Induction type Energy meter: construction, torque equation. Measurement ofpower and energy.

Module 4

Study of logic circuits: NOT, AND, OR, NAND, NOR, XOR & XNOR gates with schematic symbol and truth table

Study of Boolean Algebra: Laws, rules, and theorems, of Boolean algebra, sum of products (SOP)form, product of sum form (POS), of Boolean functions, study of K-maps restricted 4 variables onlyCombinational logic: analysis of half adder, full adder, encoders and decoders

PRACTICALS (Suggestive)

1. Speed control of DC shunt / compoundmotor.
2. Ward Leonard method of speed control of DCmotors
3. Study of 3-pointstarter
4. To find out various parameters of induction motors by direct loadtest
5. Study of DOL and star deltastarter.
6. Measurement of power by two wattmetermethods
7. Measurement of energy by 1-Ø energymeter
8. Performance of Logic Gates
9. BooleanEquation
10. Reduction using BooleanAlgebra

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. Malvino& Leach, Introduction to micro processors, Tata McGraw Hill Pub., NewDelhi
2. Morris Mano, Digital Logic & Computer design, Prentice Hall of India, NewDelhi
3. Theraja.B.L. A text Book of Electrical Technology, S. Chand Pub.

REFERENCE BOOKS

1. Millman&Halkias, Integrated electronics. Tata McGraw Hill Pub, NewDelhi
2. Sawhney.A.K. A course in electrical and electronic measurement and instrumentation, Dhanpat Rai & Sons, NewDelhi.
3. Pillai.S.K. A First Course on Electrical Drives, New Age International, New Delhi,2007.
4. Nagrath.I.J. &Kothari.D.P, Electrical Machines, Tata McGraw-Hill, New Delhi,1998

MN.3.3 - MECHANICS OF SOLIDS

Course Objective: Analyzing simple structural elements subjected to direct Tension/compression, Bending, Torsion and combination of these loads will help the students to take up, at a later stage,rock mechanicsproblems.

Instructional Objective: The course enables the students to take up further study in Theory of Elasticity and related topics.

TeachingScheme:
Lecture:3Hrs/week
Sessional:25Marks

ExaminationScheme:
Theory: 100Marks
Practicals: 2Hr/week

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Stress, Strain and deformation of bodies: Rigid bodies and deformable solids-tension, compression, and shear stresses, deformation of simple and compound bars, thermal stresses, elastic constants, volumetric strains, thin cylinders and shells, deformation of thin cylinders and shells, stresses on inclined planes, principal stresses and principal planes, Mohr circle ofstress

Module 2

Loading and stresses on Beams: Types of loading, shear force and bending moment, cantilevers, simply supported beams and over-hanging beams. Theory of simple bending, bending stress distribution, load carrying capacity, proportioning of sections, leaf springs, fletched beams, shear stress distribution

Module 3

Torsion: Torsion of circular shafts, close and open springs Struts and Columns: Struts and core of section, stability of columns, Euler‟s critical load fordifferent end conditions of column, empirical formulae for buckling loadMembers subjected to combined load: Shafts subjected to bending moment and twisting moment,members subjected to bending and directedtension/compression

Module 4

Energy principles: Strain energy under different loading conditions, Maxwell‟stheorem,Catigliono‟s theorems, deflection of structures using virtual load method Theories of failures: Various theories of failures and their limitations, comparisons and applications

PRACTICALS (Suggestive)

1. Tension Test on Steelbars.
2. Compression Test on Concrete Cubes /Bricks/Stoneetc.
3. Shear Test on Steelbar.
4. Flexure Test on Timber/Tile.
5. Charpy ImpactTest.
6. HardnessTests.
7. SpringTest.
8. Verification of Maxwell'sTheorem,
9. Verification of Principle ofSuperposition.
10. Torsion Test.

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. Srinath, L. N., Advanced Mechanics of Solids, Tata McGraw Hill Pub., New Delhi,1994
2. Bhavikatti, Strength of Materials, Vikas Publishing House, New Delhi,2003.
3. Kazmi S.M.A., Solid mechanics, Tata McGraw Hill Pub, NewDelhi

REFERENCE BOOKS

1. Beer Ferdinand, Johnson E. Russel, Mechanics of Materials, Mc Graw HillBook.
2. Ramamrutham. S., Strength of Materials, Dhanpat Rai Publishing Co. (P)Ltd
3. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi,1997
4. Junakar.S.B. Mechanics of Structures Vol I., (21st Edition), Charotar Publishing House Ltd., Anand, India,1995.

MN.3.4 – ELEMENTS OF MINING ENGINEERING

Course Objective: Introductory information on mining industry, mineral potential, basic principles of extraction and the regulatory bodies will be the stepping stone to appreciate mining engineering as an important branch of engineering. Drilling and blasting remains an important operation in rock excavation and any excavation needs protection fromcollapse.

Instructional Objective: This course will enable students to demonstrate the importance of mining in national economy, understand the terminology associated with the discipline and be familiar with the available regulatory mechanism to enable safe & sustainable mining operations. The course also equips the students with detail knowledge on various engineering techniques used for drilling, blasting, roof support and allied activities in mine construction for exploitation ofminerals.

TeachingScheme:
Lecture:3Hrs/week
Sessional:25marks

ExaminationScheme:
Theory (3Hours): 100marks
Oral: 25Marks
Tutorials: 1 Hr/week

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

The Mining Industry: Mining as basic industry for raw material for other industries. Different stages in mining. Unit operations.Classification of mines.Indian mineral industry – status, organisations, activities.Introduction to National Mineral Policy.

Mineral Wealth: Availability of minerals in India and worldwide. Mineral Trade.World bodies/cartels in mineral trade.Concepts of exploration & prospecting.Mineral reserves as a function of technological growth.Foreign collaboration and Foreign Direct Investment in Mining.Indian efforts for exploration abroad.Status with respect to sea bed mining.

Mining Terminology: Mining, Mine, Mineral, Rock, Ore, Ore body, Mineral deposit, Country rock, Hangwall, Footwall, Overburden, Seam, Vein, Lode, Dip, Strike, Outcrop, Grade of ore, Tenure, Development, Adit, Shaft, Incline, Tunnel, Drift, Crosscut, Level, Raise, Winze, Sump, Stoping/Depillaring, Stope, Goaf, Caving, Subsidence, Stowing.

Module 2

Drilling for blasting: Types and principles of drilling. Principles of operation of Coal drill, Jack hammer, Wagon drill, Down the hole drill, Drill rigs. Drilling pattern in opencast mines.Drilling pattern for underground drives.Types of drill bits.

Explosives and Accessories: Basic composition of explosives. General classification and classification as per Indian Explosive Act.Properties of Common explosives.Permitted Explosives.Bulk explosives. Composition and construction of initiators such as Safety fuse, Plain Detonator, Electric Detonators, Detonating Fuse, Delay Detonators and Detonating Relay. Blastingtools.Regulations on storage and use of explosives.Explosive Magazines.Disposal of explosives.

Module 3

Blasting: Theory of blasting.Charging of blast holes, stemming, decking.Direct and Inverse initiation.Delay Blasting.Firing sequence in opencast benches. Pulsed infusion shotfiring. Solid blasting in coal mines. Ring hole blasting. Various controlled blasting techniques. Calculation of explosive requirement and powder factor.Concept of spherical charge.Crater blasting. Need of ubgrade drilling. Secondary blasting. Safety aspects in blasting with respect to flying fragments, danger zone, misfires, blown out & blown through shots. Concept of under-water blasting.Latest developments in blasting.Mine regulations on blasting.

Module 4

Roof Supports: Concept of Pressure Arch Theory. Yielding and non-yielding supports.Description of different types of supports. Fore poling in loose rocks. Roof testing. Prop setting. Support of roadway junctions.Support of roadways with excess height.Side lagging.Hydraulic and FrictionProps. Prop withdrawal. Mining legislation on supports.

TEXT BOOKS

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

REFERENCE BOOKS

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

MN. 3.5 – MACHINE DRAWING & CAD

Course Objective: Drawing is the language of engineers. Computer Aided Drawing is an essential skill required in mine planning.

Instructional Objective: The course equips the students with drawing skills and ability to use AutoCAD for various drawings.

TeachingScheme:
Lecture:1Hr/week

ExaminationScheme:
Theory: 100Marks

Tutorial: 1 Hr/week
Practicals: 3 Hr/week
Duration : 4hrs

Sessional: 25 Marks
Practical: 25 Marks

Weightage of Marks:
Module I: 2 questions of 15 marks each
Module II: 2 questions of 15 marks each
Module III: 1 question of 35 marks
Module IV: 1 question of 35 marks
Module III and Module IV are compulsory. Answer one question each from module I and module II

Syllabus Content

Module 1

Assembly drawing: Assembly of machine parts. Preparation of assembly drawing of simple machine parts such as couplings; joints, engine parts, etc., Drawing of parts and subassembly from assembly drawing. Limits, fits and tolerances for design and drawing of components and assemblies. Introduction to computer graphics, Graphic display devices.

Module 2

Computer-aided drawing: Familiarising with the menu. Absolute, relative and polar co-ordinate system. Drawing basic objects: point, line, circle, arc, ellipse, polygon, rectangle, multi line, doughnut.Drawing with precision: drawing construction lines and rays, calculating areas, calculating distance and angle, use of measure, divide, inquiry command.

Module 3

Section drawings: Convention for sectioning of machine components in computer graphics, Section of simple machine components. Use of interactive menu-driven software for preparation of line drawing; graphic coordinate system; interactive computer graphic draw erase, move, rotate, mirror and hatch; introduction to mathematical concept for line, circle and curve drawing; Scan conversion, real time scan conversion, Run length encoding, Character display, Window clipping, Geometric transformations, Visible line and visiblesurfaces.

Module 4

Disassemble drawings with bill of materials: Drill jig, Connecting rod, Crane hook, Tailstock of milling machine, Hydraulic control valves etc.

PRACTICALS

Practical will capture different features of AUTOCAD and apply it to the drawing relevant to various mining aspects. At least six sheets on assembly and six sheets on disassembly (including practice sheets), among which two sheets of each category should be done with Auto CAD

TEXT BOOKS

1. Siddheshwar, N., Machine drawing, Tata McGraw Hill Pub., NewDelhi
2. N.D. Bhatt, Machine Drawing, Charotar Pubs, Anand
3. Gill P.S., Machine Drawing, Tata McGraw Hill Pub., NewDelhi

REFERENCE BOOKS

1. Gopal Krishna, Machine Drawing, 17th Edition, Subhas Stores Books Corner,Bangalore
2. George Omura, Mastering AutoCAD, B.P.B. Publications, NewDelhi
3. Raker& Rice, Inside Auto CAD, Edition 3., New Riders Pub., 1987
4. Sham Tickoo, AutoCAD 2012 A problem solving approach, Delmar,USA

MN.3.6 – MINING GEOLOGY- I

Course Objective: Basic Knowledge and skills in those aspects of geology is a must for mining engineers for appreciation of rocks and minerals and economic practices in mining.

Instructional Objective: The course provides for basic knowledge on identification of various rocks & minerals by verifying the physical properties and equips the students with the ability toappreciate the structure of earth and ore formations.

TeachingScheme:
Lecture:3Hrs/week
Practicals:2Hr/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3Hours): 100Marks
Sessional: 25 Marks
Practical: 25 Marks

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The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Physical Geology: Role of Geology in Mining Engineering- scope & applications. Internal structure and composition of the earth.Introduction to plate tectonics & types of plates.Earth process- weathering, grades, drainage patterns and geomorphic features.Role of running water, wind, glaciers.Ground water- origin, occurrence.Earthquakes and volcanoes (Engineering importance only). Mountains, planes and plateaus in shaping the earth.

Module 2

Mineralogy: Mineralogy of industrially important metallic and non-metallic minerals. Theories of ore formation including secondary enrichment processes.An outline of ore microscopy. Physical properties of minerals- study of Quartz, Feldspar, Mica, Pyroxenes, Amphiboles, olivine and garnet groups. Preliminary treatment on strategic, critical and essential minerals.Elements of crystallography &mineralogy.

Petrology: Petrology of igneous, sedimentary and metamorphic rocks including formation, texture, structure, composition, description and classification. Deformation of rocks and resulting structures Physical properties of rocks including porosity, permeability and capillarity.An introductions to modern theories of tectonism.

Module 3

Structural Geology: Structural features of rocks- true dip, apparent dip and strike. Study of Geological structures- definition and classification of faults, folds, identification procedure.Joint systems- types.Non-conformities & their types- recognition and engineeringimportance.

Stereographic projections, and fracture analysis applied to mining operations. Geology of fuels.Importance of structures in oil accumulation.An outline of structural settings for ore deposits.

Module 4

Stratigraphy: Principles of stratigraphy, geological time scale, fossils and their uses: major geological formations of peninsular India-geographical distribution, classification, Lithology and economic importance of Dharwar system, Cuddapah system, Vindhayan system, Gondwana system and Deccan trips. Stratigraphy of Goa, Study of regional geology: interpreting geological maps and plans, practical site investigation procedures, collection of structural (geological) data.

PRACTICALS (Suggestive)

1. Megascopic study of minerals: Physical properties, identification, chemical composition, mode of occurrence, distribution and uses of rock forming minerals of minerals, study of Quartz group, Feldspar group, Mica group, Pyroxenes, Amphiboles, olivine and garnet Preliminary treatment on strategic, critical and essentialminerals
2. Megascopic study of rocks: Study of Physical properties, texture, structure pathogenesis of igneous, metamorphic and sedimentary rock engineering properties of rocks-field and laboratorytests
3. Structural Geology: Exercises on Structural maps of geological sites and interpretation of geologicalconditions.
4. Dip & strike, determination of thickness of rocklayers/beds

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. Read.H.H. Rutley"s Elements of Mineralogy, Murby,London
2. Mukherjee.P.K. A Text Book of Geology, WorldPress
3. Billings M.P: Structural Geology, Prentice Hall, Cliffs,1984

REFERENCE BOOKS

1. Chenhakesavulu: Text book of Engineering Geology, 2nd edition, 2011, Mcmillan Publishers, India
2. Ford W.F: Text book of Mineralogy, Wiley EasternLtd
3. Tyrell G.W: Principles of Petrology Methuen B.I Pub, New Delhi,1989
4. Gokhale N.W: Manual of Geological maps, CBS Pub, New Delhi,2000
5. Gokhale.N.W. Manual of Problems in Structural Geology, C.B.S.Publications.

MN 4.1 – MINE DEVELOPMENT

Course Objective: Mining starts with detail study of the ore body and calculation of reserves. Application of the techniques for specific construction like shaft sinking, tunnelling, raising and winzing is the core of mining engineering studies.

Instructional Objective: The course equips the students with ability to understand the exploration practices and reserve estimation. The understanding of ore body is applied in determining the methods of opening up thedeposit.

TeachingScheme:
Lecture:3Hrs/week
Tutorials:1Hr/week

ExaminationScheme:
Theory: 100marks
Sessional: 25 marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Exploration and Boring: Stages in exploration such as locating mineralised area, initial exploration, development exploration, exploitation exploration. Surface and Underground methods of exploration.Boring.Types of drill bits.Hole sizes. Diamond drilling: surface arrangements, feeding mechanism, core barrel, core box.Core sampling.Core recovery.Calyx drilling.Auger drilling.Wireline drilling. X-ray drilling. Continuous core rigs.Underground boring.Water loss in drilling.

Sampling and Reserve Estimation: Methods of sampling: stratified sampling & pattern sampling. Sample preparation for analysis. Coning & quartering. Methods of reserve estimation: area of influence, triangular, cross sectional, longitudinal section, block method and graphical methods. Cut-off grade.Average width.Computation of reserve.Mineable and workable reserves.Basic principles of reserve classification.United Nation Framework Classification.

Module 2

Opening up a mineral deposits: Selecting location of opencast entry. Box cut, trenches and bench formation. Sequence of development.Stripping ratio.Elements of opencast bench.Determining height & width of benches. Haul roads. Development of a seam deposit in opencast mining.Opening and development for massive ore body in opencast mining.Underground entry.

Applicability and comparison of entries. Selection of site.Shape & size of underground entries. Examples of opening up gently dipping ore body, inclined deposits, steeply inclined deposits and scattered deposits. Comparison of coal mining and metal mining.Development into panels/blocks. Factors determining panel/block size. Basic principles of coal mine/ metal mine development. Mine regulations on mine entries.

Module 3

Shaft Sinking: Marking centre of shaft. Drilling & blasting in shaft sinking. Shaft centering arrangement.Dealing with water. Ventilation and lighting during shaft sinking. Special methods of shaft sinking: Caisson method, Piling method, Freezing method and Cementation method. Deepening and widening of shaft. Mine regulation on shaft.

Module 4

Tunnelling: Selection of size and shape of drift, level and crosscut.Basic cyclic operations. Types of drilling, loading and hauling machines used in tunnelling. Drainage & ventilation.Temporary and permanent supports.Maintaining gradient and direction.Tunnel borers. Calculation of cycle time and rate of progress. Mine regulations on development headings.

Raising and Winzing: The unit operations. Methods of raising: two compartment method, Longhole method, Drop raising. Difficulties in raise drivage.Alimac Raise Climber. Raise borers. Supporting & ventilation of raises.Comparison of drilling, charging and blasting operations between raises and winzes.Specific problems in winzing.Safety regulations on inclined roadways.

TEXT BOOKS

1. Deshmukh D.J., Elements of Mining Technology Vol. 1 & 2, Denett& Co.,2010
2. Arogyaswamy, Courses in Mining Geology, Oxford & IBH Pub. Co., NewDelhi.
3. Deshmukh R.T., Mineral and Mine Economics, Myra Publications, Nagpur,1986

REFERENCE BOOKS

1. Shevyakov, Mining of Mineral Deposits, Foreign Languages Publishing House,Moscow
2. Ghosh A.K., Strategies for Exploitation of Mineral Resources, Oxford & IBH Publishing Co. NewDelhi.
3. Howard L. Hartman, Jan M. Mutmansky, Introductory Mining Engineering, Wiley,2002.
4. Charles J Moon and Whateley M.K.G., Introduction to MineralExploration.
5. Indian Bureau of Mines., Comprehensive Guidelines on Prospecting Requirements, www.ibm.nic.in

MN.4.2 – FLUID MECHANICS & MACHINERY

Course Objective: Hydraulics has a major presence in mining operations. The machines are operated by hydraulic controls. Underground cavities are filled by hydraulic stowing. Even coal transport through pipes is found more economic than others. It aims to provide general concepts of fluid mechanics and associatedmachinery.

Instructional Objective: This course will enable students to understand the behaviour of fluids and the theories governing the flow of fluids.

TeachingScheme:
Lecture:3Hrs/week
Practical:2Hr/week

ExaminationScheme
Theory: 100marks
Sessional: 25 marks
Practical: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Fluid: Definition. Types of fluids.Fluids as a continuum.Fluid properties such as Density, Specific gravity, Surface tension and capillarity. Vapour pressure. Viscosity and compressibility.Classification of fluids.Fluid statics. Absolute and gauge pressure of fluids. Measurement ofpressure.Fluid static force on immersed surfaces.Buoyant forces.Stability of floating andsubmerged bodies. Hydraulic press, cranes and lifts. Fluid kinetics.Methods of describing fluid motion.Lagrangian and Eulerian approaches. Types of motion.Rotational and irrotational flows.Vorticity and circulation.Velocity and acceleration.Local and convective acceleration. Potential flows. Velocity potential and stream function. Laplace equation.Uses and limitations of flownets.Methods of analysis of flownet.

Module 2

Fluid Dynamics: Forces influencing fluid motion. Types of forces.Body and surface forces.Energy and Head.Equations of fluid dynamics.Euler equation and application.Integration of Euler equation to get Bernoullis‟ equation.Momentum equation. Fluids subjected to uniform horizontal and vertical acceleration. Vortex motion.Free and forced vortex.Application of Bernoullis‟ equation in measurement of flows.Stagnation pressure. Pitot tube, Prandtl tube, venturi meter, and orifice plate. Flow nozzles, orifices, mouthpieces, notches and weirs.

Module 3

Pipe Flow: Transition from laminar flow to turbulent flow. Problems in pipe flow. Losses in pipe flow. Major and minor losses.Losses in transition.Losses in fittings and valves.Friction loss in pipe.Coefficient of friction.Commercial pipes in use.Different arrangements of pipes. Pipes open

to atmosphere. Pipe connecting reservoirs. Branching pipes. Pipes in parallel and series.Equivalent lengths.Syphons.Pipe net work.Laminar flow inpipes.

Module4

Reciprocating Pump: Construction and Principle of working, indicator diagram, Effect of acceleration and friction of liquids in suction and delivery pipes.Application of air vessels and their advantages.Coefficient of Discharge and slip of reciprocating pump.

Centrifugal Pump: Priming of pumps. Minimum starting speed. Multistage pumps. Pumps in series and parallel.Performance characteristic.Losses and efficiency of Centrifugal Pump.Operational Difficulties in Centrifugal Pump. NPSH: Mechanism of Cavitations. Working of Hydraulic Crane, Air Lift Pump, Hydraulic Ram, Hydraulic Lift and Jetpump.

PRACTICALS (Suggestive)

1. Verification of Bernoulli‟stheorem.
2. Calibration of aVenturimeter.
3. Calibration of aorificemeter
4. CalibrationV-notch
5. Calibration of rectangularnotch
6. Friction in pipes-Determination of coefficient of friction for a G.I.pipe
7. Frictional loss in pipe due to bend andnozzle
8. Reynold‟s Experiment: Demonstration of Laminar and turbulent flow.
9. Visit to industry to study various hydraulic machineryused.

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. Streeter, V. L. and Wylie, E.B., Fluid Mechanics, McGraw Hill1983.
2. Ramamritham, S. Fluid Mechanics, Hydrulics and Fluid Machines, Dhanpat Rai and sons, Delhi,1988.
3. Kumar, K.L. Engineering Fluid Mechanics(7th Edition) Eurasia Publishing House(P) Ltd, New Delhi1995

REFERENCE BOOKS

1. Bansal, R.K. Fluid Machines and Hydraulic Machines, LaxmiPublications(P) Ltd, New Delhi.
2. Modi & Seth, Hydraulics & Fluid Mechanics, Standard Book House, NewDelhi.
3. Rajput. R.K. Fluid Mechanics and Hydraulic Machines, S.Chand&Co.
4. Natarajan. M.K. Principles of Fluid Mechanics, Oxford & IBHpub.
5. Subramanya.K., Open Channel Flow, Tata McGraw hill Pub., NewDelhi

MN.4.3 – MINING GEOLOGY II

Course Objective: To study occurrence, localisation and origin of mineral deposits and their relation to the enclosing rock will help the mining engineers in the field.

Instructional Objective: The course provides for basic knowledge on economics of ore, exploration and practical site investigation.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:2Hrs/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Different methods, scope and limitation of prospecting. Reconnaisance Survey. Alluvial sampling, Pit sampling, Procedures for obtaining Prospecting Licence. Main features of Mineral Concession Rules.

Ore Reserve Classification: Classification of reserves. Understanding the terms Resourse Potential, Resource Base, Resources, Reserves, Grade, Tenor and Specification.Geological consideration and Techno-economic considerations for classification. Prospective (hypothetical) and Prognostic (speculative) Resources as per IS-12595. The three dimensional approach of United Nations Framework Classification.The codes and extended codes in UNFC.Advantages of UNFC.Impact of UNFC on Indian iron ore inventory. The main provisions of Mineral Conservation & Development Rules.

Ore Reserve Estimation: Basic principles of ore reserve calculation, Triangular and polygon methods, Average factor and area method, Mining block method, Cross section method, Average grade and arithmetic average, Cut off grade calculation, Accuracy of sampling.

Module 2

Mineral exploration procedures: Theories of ore formation, Stages in mineral exploration, Various exploration methods. Guides to Ore, Regional Guides, Geochemical Guides, Groundwater as a Guide, Geo-botanical and Biochemical Guides, Physiographic Guides, Mineralogical Guides, Rock Alteration, Stratigraphic and Lithologic Guides, Fracture Patterns as Guides, Contacts and Folds as Guides, Dislocated Ore Bodies, Ore Bodies Displaced by Intrusives, Coal and Oil Shale. Remote sensing.Satellite imaging.Sterioscope.Geologicalmapping.

Exploration Geophysics: Methods and application, Airborne versus Ground Surveys, magnetometer survey, Gravity Methods, Electrical, seismic and radiometric methods, Limitations in Mining Geophysics.

Geochemical exploration: Geochemical cycle. Distribution of elements during magmatic, sedimentary and metamorphic process. Principles, methods and andequipments for trace element analysis. Interpretation of geochemical data.

Module 3

Exploratory drilling: Types of drilling, Diamond drilling. Hole diameters. Wireline drilling.Reamer shells and TC bits.Core barrel and casing.Fishing tools.Types of drilling fluids. Sludge collection methods. Deep drilling practice. Drill hole pattern, Drill hole spacing, Bore hole deviation and its correction. Drill hole data logging. Sludge sampling,

Oil well drilling: Types of wells. Modern drilling techniques.Off shore drilling.Use of blowout prevention.Casing programme& design.

Module 4

Economic Geology: Ore, gangue, tenor, assay and grade of ore, classification of mineral deposits; ore forming processes-magmatic, hydrothermal, oxidization and supergene enrichment , residual concentration, mechanical concentration and sedimentation Principles of hydrology including transmission of ground water in rock and soils, applied to surface and underground mining operations.

Economic Indian mineral deposits: Origin, mode of occurrence and distribution of following metallic minerals- iron ores, manganese, copper, Chromite, bauxite, lead and zinc; non metallic deposits-asbestos, mica, Gemstones, kyanite, barite, Magnesite, graphite, kaolin, garnet and feldspars. Petroleum deposits: origin and occurrences. Resources in India andworldwide.

TEXT BOOKS:

1. Arogyaswamy, R.N.P, Courses in mining geology, Oxford & IBH Co., New Delhi,1994
2. Krishnasway, S., India‟s mineral resources, Oxford & IBH Co., New Delhi,1984
3. Umeshwar Prasad, Economic geology, 2nd edition CBS pub NewDelhi
4. Gokhale K.V.G.K and Rao, T.C, Economic Mineral Ore Deposits of India, ThompsonPress

REFERENCE BOOKS

1. Lindgren, W., Mineral deposits, Affiliated East-West Press, 3rd edition,1983
2. C.D. Gribble, Rutley‟s elements of mineralogy, 27th edition, CBSpublishers
3. Gokhale N.W, Manual of Geological maps, CBS Pub, New Delhi,2000
4. Gokhale N.W, Manual of problems in structural geology, CBS Pub, New Delhi,2000
5. Bateman, A.M, Economic mineral deposits, John Wileypub
6. Chada.S.K. A Book of Geological Maps,C.B.S.Publishers
7. Mekinsby.H.E. Mining Geology, Asia PublishingHouse
8. Ravindra Kumar. Fundamentals of Historical Geology, WileyEastern

MN.4.4 – SURVEYING-I

Course Objective: Surveying is one of the essential services in mine. The mining enterprise maintains a survey department not only to prepare the survey plans but also to regularly measure the progress in excavation.

Instructional Objective: The course provides for basic skills in survey and correct usage of survey instruments.

TeachingScheme:
Lecture:3Hrs/week
Practicals:2Hr/week
Practical: 25 Marks

ExaminationScheme:
Theory: 100Marks
Sessional: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Basic definitions, objectives, divisions and Importance of Surveying to Engineers; Classification and Principles of Surveying, Overview of Land Surveying; Surveying measurements and errors.
Basic Surveying Instruments: Tape and Compass, Principle of reversal, EDM &accessoriesBasic Principle, Errors, Precautions and Problems;

Level: Different types and various parts, Working Principle, Temporary and Permanent adjustments, Sensitivity of level Tube, Errors and mistakes, Levelling Staff;

Theodolite: Different types and various parts -Basic terms, Fundamental lines, Temporary and Permanent adjustments, Errors and mistakes in Theodolite

Measurement of Distance: Basic definitions, Methods, Ranging; Errors-types, Corrections and Precautions; Field problems and their solutions;

Module 2

Measurement of Angles and Direction: Basic Definitions- meridians, declination-variations, local attraction, Prismatic and Surveyors Compass: Whole circle and reduced bearings. Traversing withchain and compass. Methods; Methods of repetition and reiteration; Errors and mistakes, Corrections and Accuracy;

Plane Table Surveying: Instruments, Plane table and its accessories Telescopic alidade Basic definitions, Advantages & disadvantages; Setting of instruments, Orientation, methods, Two and Three- point problem, Accuracy in plane table survey, Errors, Precautions, Plotting of details including contours

Module 3

Determination of Elevation: Basic Definitions, Dumpy level and tilting level, Curvature & Refraction, Methods; Reductions of levels. Differential levelling and field book note, Reciprocal Levelling; Profile levelling, Longitudinal & cross sectioning Trigonometric Levelling: Introduction, Errors & Mistakes in levelling, Error Propagation; heights & distance with base of the object accessible, base of object inaccessible, with instrument stations in the same vertical plane as the elevated object and instrument station not in the same vertical plane as the elevated object.

Module 4

Contouring: Contouring: Introduction, Contour interval, methods of contouring, interpolation of contours, Uses of contour maps.

Minor instruments & measurement of areas and Volumes: Use of planimeter, Clinometers, box sextant, line ranger, optical prism, and Abney level. Measurement of area and volume by Trapezoidal and Simpson's rule.

Transit Theodolite : Parts & optics of transits. Temporary & permanent adjustments.Repetition & reiteration method of measuring horizontal angles.

Measurements of vertical angles: Traverse survey. Methods of balancing traverse. Gales Traverse table.Omitted measurements.

PRACTICALS

Eight sheets covering chain & compass survey, plane table survey, longitudinal & Cross Sections.

1. Chain and Compass Surveying – 1Sheet
2. Plane Table Surveying – 1Sheet
3. Profile Levelling: Cross and Longitudinal Section of Road - 2Sheets.
4. Contouring Sectioning of a road and contouring - 2Sheets

TEXT BOOKS:

1. Punmia. B.C., Ashok Kumar and Arun Kumar, Surveying Vol. I, Firewall Media,2005
2. Kanetkar and Kulkarni, Surveying & Levelling Vol. I, A.V.G Publications,Pune
3. Basak.N.N., Surveying and Levelling, Tata McGraw HillPub.

REFERENCE BOOKS

1. David Clark and J.E. Jackson, Plane & Geodetic Surveying: Higher Surveying, Vol. 2, Constable Pub, Edition 6,1973
2. Duggal S.K. , Surveying, Tata McGraw Hill pub.
3. S.K. Husain and M.S. Nagaraj, Surveying and Levelling, Vol I & II, S.Chand andCo.

MN.4.5 – ROCK MECHANICS & GROUND CONTROL- I

Course Objective:A good knowledge of rock behaviour is essential in designing rock excavation projects. Use of Rock Mechanics knowledge in mining can solve many of the problems associated with rock pressure and rock movement.

Instructional Objective: The course provides detailed knowledge on rock properties and equips the students with the ability to carry out various tests, monitoring the rock behaviour, analysis of data and solving rock mechanics problem in mining and excavation projects.

TeachingScheme:	**ExaminationScheme:**
Lecture:3Hrs/week	Theory: 100Marks
Practical:2Hr/week	Sessional: 25Marks
Tutorial:1Hr/week	Practical: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Definition of some important terms used in rock mechanics. Application of rock mechanics in mining.Constraints in rock mechanics application. Introduction to stress analysis.Principal stresses and strains. Differential equations of static equilibrium.Mohr‟s circle of stressand circle of strain.

Module 2

Physico-Mechanical Properties of Rock: Physical properties of rock: density, porosity, moisturecontent, permeability, swell index, Slake durability index, thermal conductivity, hardness, durability, Protodyaknov index, impact strength index, point load index. Application of technicalindices of rocks in mining practice.Effect of geological parameters on engineering properties of rock mass.Introduction to general classification of rockmass.

Module 3

Mechanical & Rheological Properties of Rocks: Preparation of test specimens. Laboratory determination of mechanical properties of rocks: compressive strength, tensile strength, shear strength, modules of elasticity Poisson‟s ratio, tri-axial strength of rocks. Mohr‟s envelope.Effect of various parameters on the strength of rocks. In – situ strength. Effect of joints and fracture on mechanical properties of rocks.Dynamic wave velocities. Dynamic elastic constants: their determination in the laboratory & application in mining. Time dependent properties of rocks. Creep behaviour of rock: different stages. Rheological models.Acoustic properties of rocks.

Determination of elastic properties of rocks and rock mass based on acoustic properties.Theories of rock failure.Hoek & Brown failure theory.

Module 4

Slope Stability: Types of slope failure: plane, wedge and circular. Slip circle. Effect of clay intrusions and fault planes on slope failure.Factor of safety.Stability analysis.Determining slope stability of working benches and berms.Strengthening the slopes. Dump stability. Design criteria and monitoring system for dumps. Overburden dump stabilization.

PRACTICALS (Suggestive)

1. Preparation of rock specimens for laboratorytests.
2. Determination of porosity anddensity
3. Determination of uni-axial compressive strength ofrocks.
4. Determination of point load strengthindex.
5. Determination of tensile strength of rock by Brazilliantest.
6. Determination of Protodyakanov index of the given rockspecimen.
7. Determination of slake durability index ofrocks.
8. Determination of shear strength & punch shearstrength.
9. Schmidt hammertest

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. Obert, L and Duvall, W.I. Rock Mechanics and design of Structure in Rock John Wiley and Sons Inc., New York1967.
2. Vutukuri, V.S. and Lama, R.D. Handbook on Mechanical Properties of Rocks, Vol. I, II, III, and IV, Transtech Publication, Berlin,1974/78
3. Jumikis,A.R. Introduction to Rock Mechanics, Oxford & IBH Publishing Company, New Delhi.

REFERENCE BOOKS.

1. Peng, S.S. Ground Control, Wiley Publications, New York,1987
2. Brady, B.H.G. and Brown, S.T. Rock Mechanics for Underground Mining, Chapman and Hall,1993
3. Hoek, E. and Brown, S.T. Underground Excavations in Rocks, Institute of Mining Metallurgy,London,1980
4. Jeremic,M.L Ground Mechanics in Hard Rock Mining, Oxford & IBH PublishingCompany, New Delhi,1987.
5. Goodman R.E. Introduction to Rock Mechanics, John Wiley & Sons,1989
6. John A Hudson and John P Harrison, Engineering Rock Mechanics- An introduction to the principles, Pergamon Press,1997.

MN.4.6 – NUMERICAL TECHNIQUES AND STATISTICS

Course Objective: Numerical techniques and statistics enable to solve problems which may not be intractable analytically. This course offers various techniques which can be used to solve such transcendal equations present in real life.

Instructional Objective: The course equips the students to build ability to solve numerically linear system of equations, algebraic and transcendental equations, differential equations and to implement the algorithm using C language.

TeachingScheme:
Lecture:3Hrs/week
Tutorials:1Hr/week

ExaminationScheme:
Theory: 100 Marks
Sessional: 25 Marks

Module 1

Solutions of equations: Solutions of non-linear equations of single variable using bisection method, false position method, Newton-Raphson method, secant method (problem solving, algorithm and computer programming), order of convergence and comparison of these methods Finite difference of interpolation: Forward, Backward, Central, divided differences, Taylor‟s, shift and averaging operators , difference of polynomials, factorial polynomial, Newton forward & Backward difference interpolation, Langrange‟s interpolation, Newton divided difference interpolation(derivation, problem solving, algorithm and computer programming), stirling‟s and Bessel‟s interpolation formula

Module 2

Numerical solution of differential equations: Picard‟s method, Taylor series method, Euler‟s method, modified Euler‟s, Runge-Kutta methods, Milne‟s predictor-corrector method (problem solving, algorithm and computer programming)
Numerical solution of partial differential equations: solution of Laplace, heat & wave equations by finite difference method

Module 3

Numerical Integration: Newton-Cote‟s quadrature formula, trapezoidal rule, Simpson‟s 1/3 & 3/8 rules, Weddle‟s rule (Problem solving, algorithm and computer programming), Romberg‟s integration (Richardson‟s extrapolation). Comparison of the above methods and error estimation
Solution to linear algebraic equations: Gauss elimination, Gauss-Jordan, Jacobi‟s, Gauss Seidal methods (problem solving, algorithm and computer programming). Comparison of above methods and concept of ill and well conditioned systems

Module4

Statistics: Axioms of probability, conditional probability, theorem on total probability, Bayestheorem; Random variables-discrete & continuous; E, V operators, MGF & properties, Standard distributions: discrete-binomial, geometric & Poisson; continuous- uniform-exponential &normal; E, V operators & MGF for thosedistributions

TEXT BOOKS

1. Grewal, B.S., Numerical methods, Khanna Pub., NewDelhi
2. Kandasamy, P., Numerical Methods, S. Chand & Co., NewDelhi
3. Montgomery, D. C., Probability and statistics for Engineers, Prentice Hall of India,NewDelhi

REFERENCE BOOKS

1. Balagurusamy, Numerical Methods, Tata McGraw Hill Pub., NewDelhi
2. Ayyub and McCuen, Numerical Methods for Engineers, Prentice Hall,1996
3. Chapra and Canale, Numerical Methods for Engineers, McGraw Hill, 1988
4.

MN. 4.7- GEOLOGICAL TOUR / CAMP

Course Objective: Seeing is believing. Mining Engineer should be very conversant with the common rocks and geologicalfeatures.

Instructional Objective: The students will have hands on experience on checking and understanding the rocks at its natural occurrence and correlate with its formation, deposition etc and also to appreciate the geological features of landscape.

Teaching Scheme: The camp or tour will be organised during vacation after III semester examinations for a duration of around one week.

Examination Scheme: Detail bound paged report shall be submitted during the semester.

Sessional: 25 Marks

Syllabus Content

The location should be selected such that the students are able to appreciate mineralogy, petrology, structural geology and weathering.

Scheme of Teaching & Examination

Third Year BE (MN) - Semester-V

L- Lecture; T – Tutorial; P – Practical; Th.Dur – Duration of Theory paper; Th – Theory; S – Sessional; O – Oral

Sub Code	Subject	Scheme of Instruction Hrs/ week			Scheme of Examination					
		L	T	P	Th. Dur (hrs)	Marks				
						Th	S	P	O	Total
MN 5.1	Surveying- II	3	-	2	3	100	25	25	-	150
MN 5.2	Rock Mechanics& Ground Control -II	3	-	2	3	100	25	-	25	150
MN 5.3	Minining Machinery- I	3	-	2	3	100	25	-	25	150
MN 5.4	Mine Management & Legislation	3	1	-	3	100	25	-	-	125
MN 5.5	Surface Mining	3	2	-	3	100	25	-	-	125
MN 5.6	Underground Coal Mining	3	1	-	3	100	25	-	-	125
MN 5.7	Industrial Training I*	-	-	4	-	-	25	-	-	25
Total		**18**	**04**	**10**		**600**	**175**	**25**	**50**	**850**

* Industrial Training I is to be carried out during summer vacation after Semester IV and the report is prepared in Fifth sem.

Note: A survey camp/project will be organised during the winter vacation after V semester and the project will be prepared in the sixth semester.

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

Third Year BE (MN) - Semester-VI

Sub Code	Subject	Scheme of Instruction Hrs/ week			Scheme of Examination					
		L	T	P	Th. Dur (hrs)	Marks				
						Th	S	P	O	Total
MN 6.1	Mining Machinery- II	3	2	-	3	100	25	25	-	125
MN 6.2	Mine Environment- I	3	1	2	3	100	25	25	-	150
MN 6.3	Mineral Processing	3	-	2	3	100	25	-	-	150
MN 6.4	Underground Metal Mining	3	1	-	3	100	25	-	-	125
MN 6.5	Mine Economics & Valuation	3	1	-	3	100	25	-	-	125
MN 6.6	Mine Surveying	3	1	-	3	100	25	-	-	125
MN 6.7	Survey Camp/ Project*	-	-	4	-	-	25	-	25	50
Total		**18**	**06**	**8**	**-**	**600**	**175**	**50**	**25**	**850**

* Survey Camp/Project is to be carried out during winter vacation after Semester V examinations, whose evaluation is done in SemesterVI.

Note: Industrial Training II is to be carried out during summer vacation after Semester VI examinations and the evaluation is done in Semester VII.

- Theory combined with Sessional is a single head of passing while P, O are independent head ofpassing

MN.5.1 SURVEYING II

Course Objectives: This course introduces advanced surveying instruments and techniques. It helps in setting out works practically. It helps in understanding the methods of hydrographic surveying.

Instructional Objectives: At the end of this course, the student will be able to:

- Understand advanced surveying techniques such as remote sensing and geodeticsurveying
- Plotting contourplans.
- Understanding different techniques of hydrographicsurveying
- Setting up ofworks.

TeachingScheme:
Lecture:3Hrs/week
Practical:2Hrs/week

Examination Scheme:
Theory: 100Marks
Sessional: 25 Marks
Practical: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Tacheometric Surveying: General principles of Tachometry and different types of tachometers. Principles of stadia methods.Determination of instrument constants.Derivations of distance and elevation formulae for vertical and normal holding of the staff.Reduction of Tachometric data.Use of tachometric tables and othergraphs.

Introduction to advanced instruments: Total Station, GPS receiver

Hydrographic Surveying: shoreline survey, river survey, soundings, methods of locating soundings, three-point problem

Module 2

Setting out works: Setting out buildings, culverts: bridges, tunnels. Instruments for setting out tunnels: surface alignment, setting from ends, transforming the alignment underground, transferring levels underground. Accuracy in tunnel surveying.

Curves: Basic definitions, Different types and their characteristics, Simple, Compound & Reverse curves. Methods of setting above curves. Transition curves. Necessity, requirements & methods of introducing super-elevation, Clothoid, Cubic &. Spiral curves. Bernoulli's lemniscates, methods of setting transition curve. Geometry, Setting out, Field problem of Circular curve, Transition curve, Combined Curve and Vertical curve.

Module 3

Remote Sensing: Introduction- Remote sensing system- data acquisition and processing; Applications; Multi concept in remote sensing. Physical basis of remote sensing. Electro-magnetic radiation (EMR)-nature, nomenclature and radiation laws; Interaction in atmosphere- nature, its effects in various wavelength regions, atmospheric windows; Interaction at ground surface- soils and rocks, vegetation, water. Remote sensing observation platform, Sensors.

Geographical Information systems: Introduction, objectives, components, topology, Data model and Data Structure, Errors in GIS, Linkage of GIS to remote sensing, Applications

Module 4

Geodetic Surveying: Definition & scope of Geodetic survey. Principles of triangulation & classification.Reconnaissance, choice of stations, inter visibility & height of stations. Signalsdifferent types. Satellite stations & reductions to centre, baselinemeasurement

PRACTICALS (Suggestive)

1. Determination of reduced levels usingTacheometer.
2. Determination of reduced levels using TotalStation
3. Setting out of a typical Buildingplan
4. Setting out of different types ofcurves
5. Study of soundingmethods.
6. Drawing of contour map for a specifiedarea

It is mandatory to perform eight experiments based on the above list. More than eight experiments are,however, encouraged.

TEXT BOOKS

1. B.C. Punmia, Ashok Kumar and Arunkumar, Surveying Vol. I, II, III, Firewall Media,2005
2. Kanetkar and Kulkarni, Surveying & Levelling Vol. I & II, A.V.G Publications,Pune
3. David Clark and John Erick Jackson, Plane & Geodetic Surveying for Engineers, Constable Publishers

REFERENCE BOOKS

1. S.K. Duggal, Surveying, Tata McGrawHill Pub., New Delhi,2004
2. Jawahar Lal Sharma, A Text Book of Advanced Surveying, C.B.S. Publishersand
3. Distributors, 1985.
4. Ghosh, Mine Surveying, Lovely Prakashan Publishers anddistributors.
5. Ghatak, Mine Surveying Vol. I, II, III, 5th edition, Coal Field Publishers,1996

MN.5.2 ROCK MECHANICS & GROUND CONTROL-II

Course Objective: Safe underground excavations need detail knowledge on rock mechanics. Underground constructions are required not only for mining but also for tunnels, hydro-power generation and various other utilities.

Instructional Objective: The course enables the students to understand the behaviour of rocks useful for designing safe underground constructions.

TeachingScheme:
Lecture:3Hrs/week
Practicals:2Hrs/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks
Oral: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Module 1

Stress Analysis Around Underground Excavation: Introduction, Pre-mining and Induced Stresses, Pressure Arch Theory. Stress distribution around single excavation, circular, multiple, pillar and irregular shapes. Analytical approaches such as numerical models, FEM, BEM, DEC. Types of stress-strain measuring instruments such as load cells, strain gauges, etc. Convergence measurement instruments such as dilatometers, extensometers, optical gauges, compressometers, etc. In-situ strength properties of rocks. In-situ stress measurement such as Plate load test, Cable jack test, Bore hole test, Dialatometer test, hydrofracturing, etc. Methods of monitoring rock movement and their limitations.

Module 2

Rock Mass Classification: Introduction. Development of classification methods through Terzaghi, Lauffer, Poacher and NATM (New Austrian Tunnelling Method). Rock Quality Definition Index (RQD). Rock Structure Rating (RSR) system by Wickham.Significance of RSR system. Rock Mass Rating (RMR) by Bieniawski. Parameters used to classify rock mass using RMR system. Modified RMR for mining.Tunnelling Quality Index (Q). Parameters considered in formula for calculation of Q. Concepts of Stress Reduction Factor (SRF) and Excavation Support Ratio (ESR). Comparison of RMR and Q. Application of Rock Mass Classification in solving mining problems.

Module 3

Underground Supports: Redistribution of rock pressure on conventional and Powered supporting, Theory of reinforcement of rock mass by Rock Bolting, Cable Bolting, Roof Trusses, Shotcreting, fibre reinforced shotcreting etc. Support layouts, Estimation of support resistance. Rock Structure interaction. Relation between support resistance and rock mass quality. Design of support systems

in tunnels, shafts, headings, junctions, depillaring areas, gate roadways, longwall faces and stopes. The system of spot bolting and pattern bolting.Mechanism of support by cable bolting. Forces and displacements associated with cable bolting. Roof stitching.

Module 4

Caving: Mechanics of caving.Cavability of rocks.Induced caving.Design of Pillars. Determination of shape and size of pillars in coal and hard rock mines. Barrier pillars.

Rock burst and coal bumps: Mechanism, causes, occurrence, estimation of damage, prediction and preventive measures.

Subsidence: Theories of subsidence. Factors affecting subsidence.Sub-critical, critical and supercritical widths of extraction.Subsidence prediction and control.Design of shaft pillar.

Stowing/Filling: Mechanism of strata control by stowing.Specific precautions while stowing.Effect of shrinkage of stowing material.

PRACTICALS (Suggestive)

1. Practice in use of load cells, straingauges.
2. Practice in use of dilatometers, extensometers, optical gauges,compressometers.
3. Estimation of "Q" for a given rock masscharacteristics.
4. Application of rock mass classification in solving miningproblems.
5. Design of support layout for a given area underground.
6. Estimation the subsidence area and damage to thesurface.
7. Estimation of "RMR" for a given rock masscharacteristics.
8. Estimation of stresses around mineopenings.
9. Design of hydraulic stowingparameters.

It is mandatory to perform eight experiments based on the above list. More than eight experiments are, however, encouraged.

TEXT BOOKS

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

REFERENCE BOOKS

1. M. L. Jeremic, Ground Mechanics in Hard Rock Mining - Oxford & IBH Publishing Co. New Delhi,1987.
2. C. Biron & E. Arioglu, Design of Supports in Mines -, John Wiley & Sons, N Y,1983.
3. Brady and Brown, Rock Mechanics for Underground Mining - 2nd edition, Kluwer Academic Publishers,1993.
4. R. E. Goodman, Introduction to Rock Mechanics - 2nd edition, John wiley and Sons,1989.
5. John A. Hudson and John. P. Harrison, Engineering Rock Mechanics, An Introduction to the Principles - Pergamon Press1997.
6. Brady and Brown, Rock mechanics for underground Engg. Chapman and Hall,1993

MN.5.3 - MINING MACHINERY-I

Course Objective: Mining industry uses heavy earth moving machinery to meet the production demand. The knowledge of HEMM parameters helps in choosing the correct combination of machinery.

Instructional Objective: The course enables the students to be familiar with the various machines used in opencast mine, their construction and performance.

Teaching Scheme:
Lecture:3Hrs/week
Practical:2Hrs/week

Examination Scheme:
Theory: 100Marks
Sessional: 25 Marks
Oral: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from eachmodule for term end theory examination. Total five questions to be answered taking minimum onequestion from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Hydraulic Transmissions: Fundamentals of hydraulic transmission. Cylinders and accumulators.Differenttypes of valves, hydraulic coupling and torque converters, Application in mines, Advantages of hydraulictransmission.

Mine Pumps: Types of pumps. Working head and efficiencies for centrifugal pumps.Multistage pumps.Performance Characteristics.Reciprocating pumps.Construction details.Application of air vessels.Mechanism of cavitation.Turbines.Working principle.Selection, operation and maintenance of pumps.Pump fittings. Submersible pumps. Slurry pumps. Special types of pumps used in mines. Corrosion in minepumps.

Module 2

Compressors: Thermodynamics in air compression. Multi-stage compression.Centrifugal Compressors.Its principles of operation.Adiabatic efficiency. Design consideration for impeller and diffusion systems.Performance characteristics. Axial Flow Compressors: Elementary theory. Stage efficiency and overall efficiency; Performance characteristics.Axial flow and radial flow turbines.Impulse and reaction turbines.Fundamental relations and velocity triangles; Aerodynamic and thermodynamic design considerations.

Prime Movers: Diesel engines. Classification and basic construction features. Operation and maintenance of its subsystems.Trouble shooting of the engine. Types of electrical motors used in HEMM. Thyristor controlled devices. Concept of Motor generator.Basic understanding of prime movers in used in HEMM.

Module 3

Excavation and Loading Machinery: Classification. Hydraulic system diagram.Under carriage. Construction details of Front end loaders, Backhoe and Power shovel. Dragline and its balancing diagram. Bucket Wheel Excavator. Bucket Chain Excavator. Surface Miners.Design, construction and maintenance of opencast loading and hauling machines.Criteria for selection and performance of excavating and loading equipment.Continuous Miners.Mine regulations on Heavy Earth Moving Machinery.

Auxiliary Machinery: Rippers and Dozers. Types of dozer blades.Technical specification of rippers.Brief description of Grader, Scrapper, Clamshell, Lump breaker, Stacker, Spreader, Reclaimer etc.Cranes.Other ancillary opencast machines.Their application. Description and use of Transfer conveyors, Mobile conveyor bridgesetc.

Module 4

Drilling Machines: Design, construction and maintenance of opencast drilling machines.Rotory blast hole drills. Wagon Drill. Down the hole drills. Jack hammer drill. Components of drill machine. Different typesof drill bits and drill rods.

Transporting Machines: Classification of transport equipments.Understanding of construction and technical specifications of dumpers.Types of conveyors. Construction details of conveyors. Belt, pulley and idlers.Brief introduction of booster belt conveyor, cable belt conveyor, high angle belt conveyor etc.Construction of Aerial Ropeway. Application, advantages and disadvantages of aerial ropeways.Applicability of rail transport system for surface transport. The concept and applicabitlity of hydraulic transport.Mine Regulation on transportMachinery.

PRACTICALS (suggestive)

1. Experiments to obtain the characteristic curves of centrifugalpumps.
2. Experiments to obtain the characteristic curves of reciprocatingpumps.
3. Study of mine pumps and its parts by visiting theworkshop.
4. Study of different parts ofcompressor.
5. Various tests on diesel and petrolengines.
6. Study of maintenance schedule ofexcavators.
7. Study of various auxiliary equipments at mineral stockyard.
8. Study of different parts of drillingmachine.
9. Study of dumpers and theirspecifications.

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

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

REFERENCE BOOKS

1. S. Ghatak, Mine Pumps Haulage and Winding, Lovely PrakashanPub
2. AmitoshDey, Heavy Earth Moving Machinery, Lovely PrakashanPub
3. Bill Robertson, Caterpillar Earthmovers, Iconografix USA July2004.
4. Eric C Orleman, Heavy Earthmoving Equipments, Motorbooks International, October1995.

MN.5.4 - MINE MANAGEMENT & LEGISLATION

Course Objective: There is multiplicity of legislations governing mining activities. Knowledge on the essence of such legislations is essential to effectively and legally managing the mines.

Instructional Objective: The course enables the students to understand the organisational structure and management concepts for mining enterprises to effectively manage them within the frame work of rules andregulations.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Organisation, administration and Management: General principles of management. Functions of management.Management skills.Scientific management.Management by objectives.Levels of management, Administration and management.The functions of organisation.Types of organisation.Essentials of a good organisation.Characteristics of mining enterprise.Organisational structure of mining enterprise.

Statutory Requirements of Personnel at Mines: Statutory persons as per Mine Regulations. Competent persons.Mine officials.Essential qualifications and norms of appointment of competent persons in mines.

Module 2

Personnel Management: Functions of personnel management, recruitment, selection, training and development of human resources. Promotion and career development.Job evaluation and performance appraisal.Motivational techniques and incentives. Manpower Planning in mines. Communication and leadership qualities

Module 3

Material Management: Introduction. Material planning.Inventory control.Classical EOQ Model.Calculation of Economic Order Quantity.Inventory optimisation.Purchase and stores.Nature of inventory.ABC analysis.VED, SDE and MNG analysis.

Industrial Relations: Causes of industrial disputes. Industrial discipline, Grievance redressal mechanism.Trade union movement.Adjudication.Workers' participation in management.Decision making and problem solving.Conflict management.Value analysis in management.Important provisions of Payment of Wages Act, Workmen‟s Compensation Act and Employee State Insurance Act.Hours and limitations of employment as per Mines Act.

Module 4

Mining Legislations: An overview of different aspects covered in various Acts, Regulations and Rules related to mining such as management, safety, welfare & hygiene, mineral conservation, environment protection etc. Main provisions of Mines Act.Duties and responsibilities of Mines Manager, Mine Foreman, Mining Mate, Surveyor and other competent persons appointed at mines under Mine Regulations. Welfare Amenities specified under Mines Rules. The standards for drinking water, toilets, rest rooms, canteen, cretch, pit head bath etc. First aid facilities at mines.Provisions for establishing training centers/facilities for every mine under Mine Vocational Training Rules.Initial and Refresher Training requirements.Equipments and personnel at training centres.

TEXT BOOKS

1. R S Naagarazan, A text book on Principles of Management, New Age InternationalPub.
2. Banga and Sharma, Industrial Organization and Engineering Economics, Khanna Publication,New Delhi,1999.
3. Rakesh & Prasad, Legislation in Indian Mines: A Critical Appraisal, Lovely PrakashanPub.

REFERENCE BOOKS

1. Buffa, Modern Production Management, John Wiley and Sons,1998.
2. O.P.Khanna, Industrial Management, Dhanpat Rai and Sons,1999.
3. V.N. Singh, Mine Management, Lovely Prakashan, Dhanbad.2003.
4. Rakesh and Prasad, Mine Management, Legislation and General Safety, Vol I and II, Lovely PrakashanPublishers

MN.5.5 SURFACE MINING

Course Objective: Energy and mineral demand is growing exponentially worldwide. Surface mining having large potential for very high production is the only way to meet the demand.

Instructional Objective: The course enables the students to apply the knowledge of mining machinery in their economic deployment for achieving the production targets jn opencast mines.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:2Hrs/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Scope of surface mining in India. Ore bodies amenable to opencast mining. Advantages and disadvantages of opencast mining over underground mining.Classification of mines.Preparation of site.Grubbing, scarification, ripping and dozing.Selection of machinery for site preparation and opening up.Different methods of opening up the deposits.Methods of driving Box cuts. Pit expansion process. Sequence of extraction and bench formation.Mine regulations on working near mine boundaries, steep working etc.

Open Pit Design and Layouts: Important parameters of Open pit design; Design of Benches. Mine Regulations on height, width and slope of the benches. Measures adopted for slope stability. Concepts and significance of stripping ratios. Break even stripping ratio. Life of the mine.Layout planning for horizontal, inclined and steep deposits.Factors influencing the choice of layouts.Layouts with in-pit crushing and conveying.Working benches and protective berms. Final pit slope angle and pit limit. Unit operations in opencastmining.

Module 2

Surface Mining Methods: Sidecasting and Overcasting. Strip mining. Quarrying.Placer mining.Non-cyclic surface mining with Bucket wheel excavators and Continuous surface miners. Selection of methods for bedded deposits, massive deposits, pipe type, cap type and vein type deposits. Mining ofbeach sands.Introduction to placer mining.Dimensional stone mining.Surface mining over underground workings.Mining in fiery strata.Problems in deep mining. Slopestabilisation.

Dump Formation : Types of waste dump - internal and external; dump formation methods and equipments used. Layout of waste dumps. Stabilization of Waste Dumps.Mine regulations on overburden dumps.Reclamation methods using different combination of equipments.

Module 3

Cutting and Loading Operations: Basic principles of equipment selection. Selection of machinery for digging and cutting.The concept of digging face, shovel approach, crowding, swing angle, depth of cut etc.Selecting optimum bucket capacity.Working out production capacity of hydraulic shovel. Application of back hoe, dragline etc. Application of wheel loader and tractor shovel and selection of loader bucket capacity. Application of ripper-dozer and estimating dozer production.

Mine Transport: Overview of various transport systems used in mines. Application of Bottom dump wagons. Comparison of transport by rigid frame dump trucks and articulated dump trucks. Haul road geometry and construction material. Design of curves and gradients.Maintanance of haul roads. Machinery requirement, Working out the haulage cycle and determining number of haul trucks. Application of Queueing Theory to the loading and hauling problems.Management of haul fleet.Operator Independent Truck Despatch System. Comparison of the systems used for long distance transport such as belt conveyor, railway and rope way. Application of high angle conveyors.Safe transport of ore through public roads.

Module 4

Drilling and Blasting: Selection of drill machines for open pits. Factors affecting drill performance. Determining number of drill machines for planned production. Factors affecting blast design. Multi row blasting, twin bench blasting (coyote blasting) and blast casting by explosives. Heavy blasting, Mine Regulations on opencast blasting Problems associated with blasting such as ground vibration, airblast and flying fragments., Sources of noise in mines. Understanding of Loudness & frequency.Effect of noise.Monitoring of noise and related instrumentation.Control of noise.Causes of ground vibration.Methods of controlling adverse effects.Monitoring ground vibration and related instrumentation.

TEXT BOOKS

1. G.B. Misra, Surface Mining, Dhanbad Publishers,1978
2. James, W. Martin, Surface mining equipment, MartinConsultants
3. B.A. Kennedy, Surface Mining (2nd Edition), SME Publishers

REFERENCEBOOKS

W.Huustrulid and M. Kuchta, Open Pit Mine Planning and Design, A.A. Blakema Pub
Bhandari, Blasting Engineering operations, Elsevier
John Sinclair, Quarrying, Open cast Mining and Alluvial Mining, Elsevier Pub, New yorkS.K.Das, Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994.
D.J.Deshmukh, Elements of Mining Technology, Vol.I, Central Techno Pub, Nagpur, 1998.
R.T. Deshmukh, Opencast Mining –M. Publications, Nagpur, 1996.

MN.5.6 UNDERGROUND COAL MINING

Course Objective: Energy demand is pushing the coal mining to increased extraction by most modern methods. The productivity and percentage of extraction needs to increase many fold.

Instructional Objective: The course enables the students to appreciate various coal mining methods and to ably manage highly mechanised mines.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:1hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Origin, Coal Formation, Coal Measuring Rocks and Their Characteristics, Rank of coal. Characteristics of Indian coal deposits. Major coal producing areas in India. Classification of coal seam as per thickness, depth and inclination., Factors affecting choice of Coal Mining Methods. Grading of coal.

Coal Mine Development: Practices of opening up coal deposits in major coalfields. Design and development of panel.Transport and ventilation arrangements to and from the panel.Classification of miningmethods.

Stowing Practice: Principle, method- mechanical, pneumatic, hydraulic – merits and demerits with applicability, collection and preparation, transport, handling and storage.Arrangement for stowing on the surface and underground.Shrinkage of stowing material and its effect.

Module 2

Bord& Pillar method of working: Patterns of development within the panel. Size of panel, pillars and headings.Percentage of extraction during development.Unit operations of winning, loading and haulage.Methods of pillar extraction.Problems and issues in Depillaring, Extraction by caving and stowing methods.Systematic supporting rules.Possible mechanisation in Bord& Pillar method.Comparison of thin and thick seam mining. Work arrangement and calculation of production. Related Mine Regulations.

Module 3

Longwall Mining: Applicable conditions. Development within the panel in advancing and retreating system.Optimum length of faces. Single and double unit longwall faces. Working in dip, strike and rise directions. Cyclic and non-cyclic operations.Systematic support rules.Hydraulic support system.Mechanised cutting and loading operations. Application of DERDS, SERDS,

Armered Face Coveyors, Self advancing hydraulic supports, etc. Work organisation and calculation of production. Salvage operations in longwall mining. Mine regulations related to longwall mining.

Module 4

Thick Seam Mining: Problems in Mining of Thick Seams. Thick Seam Mining by Bord& Pillar and Longwall methods. Slice method, Sublevel Caving, Blasting Gallery Method, Cable-Bolting Method, etc. Mining with & without stowing.

Mining in Difficult Coal Seams: Horizon mining for steeply inclines seams. Winning of thin seams.Method for contiguous seams. Considerations while working seams prone to spontaneous heating, gas outbursts and bumps. Extraction of seams below important structures and below water bodies.Harmonic mining. Related MineRegulations.

Non-conventional methods: Hydraulic Mining. Coal gasification. Shield mining. Room & Pillar mining, High wall Mining

TEXT BOOKS

1. R.D. Singh, Principles and Practices of Modern Coal Mining, New Age International,1997.
2. S.K. Das, Modern Coal Mining Technology, Lovely Prakashan Publishers,1994,
3. J.G.Singh, Underground Coal Mining Methods, BrajKalpa Publishers, Varnasi, 2000.
4.

REFERENCE BOOKS

1. Coal Mining – I.C.F. Statham, Vol. I, II, III and Vol. IV, The Caxton Eastern Agencies, Calcutta
2. SME Mining Engineers Handbook on Underground CoalMining
3. Syd. S. Peng, Longwall Mining, West Virginia university, 2006
4. D.J.Deshmukh, Winning & Working of Coal, Vol. I& II, Asia Publsihing House,1967
5. T.N. Singh and B.B.Dhar, Thick Seam Mining, Oxford and IBH, 1992.
6. Vorbojev&Deshmukh, Advanced Coal Mining, Vol.I& II, Asia Publishing House,1964.
7. Christopher Higman, Gasification, Elsevier UK,2008.

MN.5.7 INDUSTRIAL TRAINING I

Course Objective: Whatever may be the research and developments in Rock Mechanics, the behaviour of rock is less predictable accurately. Mining Engineering is hence said to be an art more than engineering and the knowledge gained through experience is more valuable.

Instructional Objective: The training enables the students to experience with the practical applications of the theoretical learning. The outcome at the place of work is always much more than what can be learned in the class room.

Teaching Scheme: The industrial training phase I will be organised during summer vacation after IV semester examinations for a minimum duration of four weeks. The class shall be divided into batches of 4 or 5 students and sent to pre-determined mines from where the permissions are obtained. Students may camp at the mines or elsewhere and undergo training as per the direction of mine management. Notional teaching scheme: 4 hrs /week Practical for guidance ofstudents.

Examination Scheme: Students shall maintain a Daily Diary to record their daily activities. They shallcollect the necessary data and prepare a detail training report within two months of completion of training.The training Report neatly typed and attached with sketches, diagrams and maps shall be submitted to the department for evaluation and record. Sessional 25Marks.

Oraganisation of Training: The training places are grouped into four as below and training at any one mine
each of two different groups is compulsory.

1. **Mechanised Opencast Metal Mines:** Iron ore mines in Goa, Malanjkhand Copper Mines of HCL(Madhya Pradesh), Kudremukh Iron Ore Mine(Karnataka), RampuraAgucha Mines of HZL
   (Rajasthan), Bailadilla Mines of NMDC (Chattisgarh), any other mechanised opencast mines.
2. **Mechanised opencast mines in Coal:** Neyveli mines of M/s Neyveli Lignite Corporation,Kusmunda Mines of South Eastern Coalfields Ltd (Bilaspur, M.P.), Ramagundem mines of Singreni collieries co Ltd, mines of Central Coalfields Ltd., any similarmines.
3. **Underground Metalliferous Mines:** Mines of Manganese Ore India Ltd., Khethri or Kolihanminesof HCL (Rajasthan), Surda or Rakha mines of HCL (Jharkhand), Dariba or Zawar mines of HZL, Hutti Gold Mines Ltd, any similar underground metalmines.
4. **Underground Coal Mines:** Mines of Singreni Collieries Co Ltd (Andhra Pradesh), Mines of Western Coalfields Ltd, Mines of South Eastern CoalfieldsLtd.

Essential Contents of Training Report:

1. Name of the mine along with names of owner, agent, manager and other seniorofficials.
2. Location and a brief history of themine.
3. Brief geological description along with characteristics of the ore and its marketingscenario.
4. The surface features including mine entries, loading & transport arrangement of ore, disposal of waste, orebeneficiation.
5. Method of working including strata control in underground mines and dump management in opencastmines.
6. Sampling, survey, training and rescuesections.
7. Acknowledgements.

MN.6.1 - MINING MACHINERY-II

Course Objective: Gone are the days, when underground mining was a hazardous manual job. Every aspect of the underground mining operation is now mechanised. This course aims to provide domain knowledge of major machinery required for carrying out mining operations effectively.

Instructional Objective: The course enables the students to select appropriate machinery for various mining operations based on the production targets.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:2Hrs/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn fromeach module for term end theory examination. Total five questions to be answered takingminimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Elements of mechanical power transmission -- gear, belt, chain, coupling, clutch and brake. Various sources of power available at mines. Different types of electric power cables used in mines. Indian Electricity Rules with respect to mines. Types of Prime Movers for mining machinery.Principles of flame proof enclosures, principles of intrinsic safety and intrinsically safe apparatus. Protective relays in mine power system. Pneumatic power at mines.Principle of compressor operation.

Wire Ropes: Types and construction, rope lay, breaking strength, space factor, mass, factor of safety, fill factor,construction efficiency. Examination and care of wire ropes during storage and use. Selection of wire ropes for variouspurposes, Testing of wire ropes, Rope splicing, Different types of rope capples and process of capping, Mine regulations on wireropes.

Module 2

Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, various shaft fittings such as Keps, rope guides, platforms, Capping and recapping of wire rope, Cage and suspension gear. Different types of winding drums, Safety devices in winders such as over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle.Mechanical and electrical braking.Winding from different levels in shaft.Torque time diagram. Ground and tower mounted friction winders, Multi ropewinding.

Pit top and pit bottom layouts: run round, shunt back, lofco, traverse, turn table, tipplers. Mine tubs. Tub couplings. Mine Regulations on winding.

Module 3

Rope Haulages: Different types of rope haulages with their use and constructional details, Tension arrangement for endless haulage. Rope clips, Haulage safety devices, Rope haulage calculations

involving tractive effort, B.H.P, ideal gradient, speed & efficiency. Mine Regulations on rope haulages.

Locomotives: Different types with uses, construction and operation of diesel, battery and trolley wire locomotives, Control and breaking systems, Power and capacity assessments, Tractive effort, Drawbar pull, Breaking effort. Constructional features of shuttle cars and man riding systems. Mine Regulations onlocomotives.

Mine Track: Track work, turns and crossings, layout of tracks, switch points. Mine Regulation on care & maintenance of mine tracks.

Conveyors: Construction of different types of belt conveyors, chain conveyors, armoured flexible conveyors, stage loaders; main and extensible belt conveyors, Power calculation and selection of conveyors.

Module 4

Coal Face Machinery: Coal drill- construction, operation and maintenance. Shearers: Different types, single and double drums; fixed and ranging drums; Left hand and right hand drums, picks and pick boxes, water spraying arrangement. Road header and dint header: Types, drive arrangement, cutting, loading and propel mechanisms. Continuous miner used for bord and pillar mining operation. Construction and operation of tunnel boring machines.Selection criteria of the underground production equipments. Safety and regulations related to underground mining equipment.

Face machinery common in metal mines: Types of drill machines and their application. Jack Hammers, Simba and Jumbo drills. Mechanical Loaders: Classifications, scope of use of each in different conditions, construction and operations of scraper loader, pneumatics loaders, gathering arm loader, load-haul-dumper, low profile dump trucks, side discharge loader.

TEXT BOOKS

1. S. Ghatak, Mine Pumps Haulage and Winding, Lovely PrakashanPub
2. C. F. Statham Coal Mining Practice-Vol II, Caxton Eastern,Calcutta
3. R.D.Singh, Principles and practices of modern coal mining, New AgeInternational

REFERENCE BOOKS

1. R.T. Deshmukh, Winning and Working Coal in India, ISMAG Co op. Store ltd.,Dhanbad
2. Thomas Bryson, Mine Machinery,Pitman
3. Madisetti A Ramlu, Mine Hoisting, Taylor & FrancisPub.
4. Ernest E. Wahlstrom, Tunneling in Rock, Elseveir Scientific PublishingCompany.
5. Lewis and Clark, Element of Mining, John Wieley& Sons, NewYork
6. R. Peele, Mining Engineering Handbook by Peerl (Vol. I and II), John Wiley & SonsPub.

MN.6.2- MINE ENVIRONMENT-I

Course Objective: Mine ventilation is an essential requirement in underground mine. It is gradually becoming necessary in opencast mines also.

Instructional Objective: The course enables the students to understand the ventilation requirements, select appropriate mine fans and design suitable ventilation structures.

TeachingScheme:
Lecture:3Hrs/week
Practicals:2Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25Marks
Practicals: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Objectives of Mine ventilation, composition of atmospheric air, atmospheric pressure, Barometers. Circumstances needing ventilation support in opencast mines.
Mine Gasses: Different types of gases found in mines.origin, occurrence, physical, chemical and physiological properties of mine gases, gassiness of mines. Methane layering.Gas blowers.Instruments for detection of various gases and their working principles.Methane drainage.

Module 2

Mine Atmosphere: Permissible concentration of various gases as per mine regulations.Determination of dilution requirements.Types, source, properties and control of mine dusts.Sources of water vapour and heat in mines.Effect of humidity at the work places.Heat stroke.Hygrometer and Kata thermometer. Methods of improving cooling power of mine air.
Natural Ventilation: Factors causing Natural Ventilation Pressure. Calculation of NVP.Thermo dynamic treatment.The Motive Column.Limitations of NVP.Numerical examples on natural ventilation.

Module 3

Mechanical Ventilation: The fan house and Mine Regulations related to it. Evasee and its importance.Forcing and Exhaust system of ventilation.Central and bound ventilation system.Ventilation structures for regulation and direction of air current such as stoppings, crossings, doors, air locks and regulators.Ascential and descential ventilation.Homotropal and antitropal ventilation.Air leakages and their prevention.

Module 4

Mine Fans: Principal types of mine fans and their suitability, merits, limitation, efficiency and characteristics.Fanlaws.Atkinson‟s formula.Theoretical depression.Manometric, mechanical and over all efficiencies.Fancharacteristic curves and Mine characteristic curves.Operating point. Selection of mine fan, fan testing, output control of fans, air reversal arrangement. Series and parallel operation of mine fans.Regulations on mine fans.

PRACTICALS (Suggestive)

1. Measurement of fire damp and other gases using variousinstruments.
2. Determining dry bulb and wet bulb temperatures and calculation ofhumidity.
3. Sketching the ventilation network based on given mineplan
4. Study of various ventilationstructures.
5. Study of air reversalarrangement.
6. Measurement of head and quantity developed by a laboratory model of minefan.
7. Study of performance of axial flow fan with changingpitch.
8. Study of characteristic curves of standard mine fans and comparing it with given mine characteristiccurves.

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. V.S.Vutukuri and R.D.Lama, Environmental Engineering in Mines, Trans TechPublishers.
2. M.J.McPherson, Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication,London.
3. G.B.Mishra, Mine Ventilation and Environment, Oxford UniversityPress.

REFERENCE BOOKS

1. H.L.Hartman, Mine Ventilation and Air Conditioning, Wiley Publication,1999.
2. D.J.Deshmukh, Elements of Mining Technology Vol II, VidyasewaPrakashan,Nagpur.
3. A.Skochinsky and Komorov V., Mine Ventilation, MIR Pub.,Moscow
4. B.B.Dhar and A.K.Ghose, Mining Challenges for 21st Century, Ashish Publications New Delhi.
5. D. Pennman, J.S. Penman, The principles and practice of Mine Ventilation, CharlesGriffin
6. H. Rabia, Mine Environmental Engineering, Entrac SoftwarePub

MN.6.3- MINERAL PROCESSING

Course Objective: Minerals and rocks are not generally usable in its original form. They need processing for conversion into marketable raw materials.

Instructional Objective: The course enables the students to select the suitable parameters and appropriate machinery for processing various types of minerals.

TeachingScheme:
Lecture:3Hrs/week
Practicals:2Hrs/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25Marks
Practical:25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum onequestion from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Definition, purposes, scope and limitation of mineral processing. Economic justification. Methods of beneficiation, Unit operation in Mineral dressing, properties of mineral used in mineral dressing. Coal washing

Communition: Definition and objectives, methods of size reduction, Principles, mechanism and theory of crushing-definition, methods, crusher - classification, construction, operations and performance. Crushing circuits.selection of crusher Grinding - definition, purpose, and mechanism. Tumbling mill -type, constructions, operation and performance.grinding circuits. Reduction ratio-definition, types and significance.Breakage rate and factor affecting breakage rate.

Sizing separation: sizing - definition, purpose, method and principles. Screening - definition. Classification, equipments, screen surfaces, performance of screens and factor affecting performance Laboratory sizing, wet and dry sieve analysis, size distribution, sub-sieve techniques

Module 2

Classification: definition, application and Principles of classification, Equipment, performance of classifier and factor affecting it. Hydro cyclone design.

Concentration: Methods of concentration and their applications, Hand sorting; application, sorting surfaces, machines sorting - application, mechanics of sorting, sorting machines, Gravity separation;- definition, Principles and methods of gravity concentration, equipment and application, performance of gravity separators. Heavy media separation (H.M.S)- definition, principle, heavy media, equipment and application. Floatation-definition, principles & chemistry; reagents - collector, froather and regulator, Floatation equipments.Electrical and Magnetic Concentration-principles, mechanism, fields of applications, limitations, methods, equipment and performance.Miscellaneous methods ofconcentration.

Module 3

Dewatering: Purpose, methods of dewatering.Centrifugal operation of dewatering system. Mechanical and thermal system of dewatering - principle, construction.

Sedimentation: definition, sediment behaviour, equipment, operation.

Filtration: Constant pressure and constant rate filtration. Filtration equipments: construction, Filtration calculation(filtration resistance, pressure drop through filter cake) Introduction to Cyanidation and amalgamation methods, Leaching, Ion exchange, Solvent extraction, etc.

Module 4

Plant Practice: Purpose, and types of flowsheets.flowsheet analysis, selection of equipments, control objective, principles of automation, instrumentation, plant design, cost estimation, selection of site. Tailing dam.

Material handling: Purpose and methods of material handling. Dry handling. Stock piles,bins and hoppers. Transportation of bulk solids, slurry handling.Tailing disposal Metallurgical accounting and control: Sampling and weighing the ore, moisture and assay sampling, on stream analysis, automatic control in mineral processing.

PRACTICALS (Suggestive)

1. Study of grab sampling and different sample division techniques (visit tomine)
2. Calculation of reduction ratio of a crusher and grinder.
3. Determination of the grinding characteristics of a given mineral sample using ballmill.
4. Sieve analysis of a given sample and plotting sizing curve. Screen performance calculation

Any one of thefollowings:

i. Concentration of a given mineral sample using mineraljig.
ii. Concentration of a given mineral using Wilfleytable.
iii. Concentration of a given mineral using froth floatationcell.
iv. Concentration of a given mineral using magneticseparator.

6. Study of washability characteristics of coal sample using float and sinktest.
7. Plotting of sedimentationcurve.
8. Visit to a beneficiation plant and study offlowsheets.
9. Calculation of Screen capacity and/or Spiral classifiercapacity.
10. Study of various pollution control measures adopted at the beneficiationplant.

It is mandatory to perform eight experiments based on the above list. Performing more than eight experiments is, however, encouraged.

TEXT BOOKS

1. B.A. Wills, Mineral Processing Technology. Pergamon Press,Toronto
2. Jain, S.K., Ore Processing A.A. BalkemaPublishers
3. A.M. Gaudin, Principle of Mineral Dressing, McGraw Hill, NewYork

REFERENCE BOOKS

1. Kelly E. G. and Spoitiswoods D. J., Mineral Processing, Wiley, NewYork
2. Vijayendra.H.G., Handbook on Mineral Dressing Vikas Publishing House Pvt. Ltd.1995
3. Norman l. Wiess, SME Mineral Processing Hand book, SME of the American Institute of Mining, Metallurgical and Petroleum Engineers,1985
4. A.F.Taggart., Handbook of Mineral Dressing, Wiley engineering Hand bookseries
5. EIA Guidance Manual for Mineral Beneficiation, by Ministry of Environment & Forest, Administrative Staff CollegeHyderabad.
6. Rosenqvist, Principles of extractive metallurgy, McGraw Hill pub., NewYork

MN.6.4 -UNDERGROUND METAL MINING

Course Objective: Majority of metalliferous ore deposits are deep seated and complex in shape and size. Knowledge of standard methods is essential to apply it to the field of work, will be imparted through this course

Instructional Objective: The course enables the students to select suitable methods of working underground metal mines and decide the necessary parameters of mine construction.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Fundamentals: Present status of Indian metal mining industry. Scope and limitations of underground mining; Characteristics of metalliferous deposits.Factors determining classification and choice of stoping methods. Choice of level interval and block size, position ; excavation and equipping of shaft station, grizzly, Secondary breaking at grizzly, ore/waste bin, main orepass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for ore handling. Understanding of dilution, loss and recovery in stoping.

Module 2

Open Stopes: Overhand, underhand and breast stoping. Sublevel stoping, Long hole stoping, Applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation, supporting, haulage and ore transport in each method. Production calculations and deployment of men and machinery. Chute system of loading, Draw point system in thicker ore bodies.

Module 3

Supported Stopes: Post and pillar method, Shrinkage stoping, Cut and fill method, Applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation, supporting, haulage and ore transport in each method.

Caved Stopes: Top slicing, Block caving, Sublevel caving. Large diameter blast hole/DTH, Concept of spherical charge and Vertical Crater Retreat methods; Applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation, supporting, haulage and ore transport in each method.

Module 4

Special Metal Mining Methods: Stulled stopes in narrow veins, Squareset stoping, Elements of square set. Resuing; Mining of parallel and superimposed veins; Longwall mining in soft seams; Chatty stoping; Problems associated with faulted, geologically disturbed blocks. Problems of deep mining and their remedial measures, design and layout of stopes in rock burst prone areas. Granite packing; Non-conventional mining methods such as Solution mining, in-situ leaching, borehole mining, underground retorting.Mine Regulations on methods of working.

TEXT BOOKS

1. H. L. Hartman, Introductory Mining Engineering, John Wiley & Sons, NewYork
2. Underground Mining Methods: Engineering fundamentals and international case studies, SME Publications, New York, June2011.
3. Y.P.Chacharkar, A study of Metalliferous Mining Methods, Lovely PrakashanPub

REFERENCE BOOKS

1. Element of Mining Engineering by Lewis and Clark. AIMEPublisher.
2. A.B.Cummins, SME Mining Engineering Handbook Vol I & II, Society of Mining Engineers of American Institute of Mining, NewYork.
3. D. J. Deshmukh, Elements of Mining Technology Vol II, Denett& Co. Pub.,2010
4. Robert Pele, Mining Engineers‟ Handbook Vol I & II., John Wiley & Sons, NewYork
5. Agoshkov, Borisov, Mining of Ores and Nonmetallic Minerals, MIR pub.,Moscow
6. Jack Spalding, Deep Mining, Mining publication Ltd.Inc.
7. EIA Guidance Manual for Mining of Minerals by Ministry of Environment &Forest, Administrative Staff College,Hyderabad

MN.6.5 -MINE ECONOMICS AND VALUATION

Course Objective: Mining degree holders are employed as managers of the mine. Mining enterprise is known to have high risks of investment. Hence detail knowledge on economic parameters become essential to run the enterprise successfully.

Instructional Objective: The course enables the students to understand the economics of business enterprise to become a successful manager.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Specific features of Mining Industry. Statistics of important and strategic minerals of India.Conservation of minerals.National mineral policy.Global mineral marketing.Price forecasting and sensitivityanalysis.

Fundamentals of Book Keeping: Basic principles of Book Keeping. The journal.Double entry system.The books of account.The balance of various ledger pages.Trail balance.Trading, Working or Manufacturing Account.Suspence Account. Profit & Loss Account.Balance Sheet.

Module 2

Costing: Objectives of costing.Elements of cost. Cost Sheet. Standard costing.Fixed and variable costs, Income statements, Break Even Analysis.Depreciation.Methods of depreciation calculations.Volume-cost-profit analysis. Productivity and cost control. Profit planning.

Mine finance : Capital and its importance. Sources of finance.Shares and debentures.Equity financing and debt financing. The cost of capital.Royalty, taxes and duties; imports and exports.

Module 3

Financial Accounting: Contribution margin. Payback period, Return on capital.Time value of money.Net Present Value and Internal Rate of Return.Method of economic appraisal.Operating expenses or cash outflows.Depletion and Amortazisation. Salvage value. Major fields of study for project evaluation. Concept of opportunity cost. The reserve fund.

Feasibility Study: Objectives of Feasibility Study. Order of Magnitude, Preliminary FS and Detail FS in case of Mining Project. Elements of feasibility study. Mutually Exclusive and Non-Mutually Exclusive Project Analysis,

Module 4

Mine Valuation: Purpose of mine valuation.Major factors affecting on the value.Precautions in reserve estimation. Sample salting. The principles of mine valuation.Concept of Safe rate, Normal rate and Speculative rate of interest.Annuity and Sinking Fund.Familiarisation with the mathematical tables for Compound Interest, Present Value, Annuity, Capital Recovery Factor, Sinking Fund Factor, Hoskold‟s Factor etc. Hoskold‟s Formula for mine valuation. Morkil‟s and other classical methods for mine valuation.

TEXT BOOKS

1. Baxter C.H., R.D.Parks, Whitehead W.L and Pardee F.G., Examination and Valuation of Mineral Property, Addison-WessleyPub.
2. Ramrao T. Deshmukh, Mineral and Mine Economics, Myra Pub.,1986
3. R.N.P. Arogyaswamy, Courses in Mining Geology, Oxford & IBH Publishing Co. Pvt. Ltd., Delhi

REFERENCE BOOKS

1. Franklin and John Stermole Economic Evaluation and Investment Decision Methods (9th Edition),
2. K.K.Chatterjee, An Introduction to Mineral Economics, New Age International pub,1993
3. R. K. Sinha and N. L. Sharma, Mineral Economics, Oxford & IBH Pub. Co.
4. Indian Bureau of Mines, Indian Minerals Year Book, The University of Michigan,2002
5. T.R.Banga and S.C.Sharma, Industrial Organisation and Engineering Economics, Khanna Pub

MN.6.6 - MINE SURVEYING

Course Objective: Mining needs accurate survey for its day to day operations and production planning. The latest instruments and software can be used only in case the theory is known.

Instructional Objective: The course enables the students to select and use suitable survey instruments for data needed in planning and executing the mineral extraction.

TeachingScheme:
Lecture:3Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory: 100Marks
Sessional: 25 Marks

Syllabus Content

Module 1

Introduction: Mine surveying - definition, purpose, difficulties in mine surveying, instrument used. Role and responsibilities of mine surveyor, appointment of mine surveyor.Types of scale.Method of plotting.Enlargement and reduction of plan.Types of plan and section used in mines. Checking accuracy of mine plan, Causes of inaccuracy of mine plan. Plan and sections required for a new mine. Use of level and theodolite .

Errors in surveying: Classification & types of error, precaution against error, accidental error and the law of probability, principles of least square, true error, apparent error ,average error, mean square and probable error, weight of a error and law of weight, limiting error, acceptable limits of error (byDGMS)

Computation of areas and volumes: Area and volume of regular figure, methods of area calculations, methods of boundary area calculation, Planimeter.

Module 2

Correlation: Underground levelling ,underground theodolite survey, purpose,& steps in correlation, methods of correlation ,instrument used ,Transferring true meridian from surface control to underground base. Shaft plumbing.Direct traversing in inclined shaft. Comparison of underground and surface traverse. Control of direction and gradient in drifts, tunnels, raises and winzes; application oflasers.

Curve setting: Purpose, type of curve, Surface methods of curve setting. Road and curve setting Transition curve and super elevation. Possible obstructions/difficulties in setting curve. Vertical curve.Setting curve underground.

Stope Surveying: Purpose, methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. Tape triangulation.Traversing.Radiation. Calculating mineral output, percentage of extraction calculation

Dip and strike calculation, fault calculation, cross measure drift calculation, Bore hole calculation, Determination of true thickness from core. Subsidence survey.

Module 3

Opencast survey: Purpose of opencast surveying, control point, frame work and development of opencast survey station. Detailed survey of opencast, determination of mine boundary, photometric survey in opencast, measurement of stripping, mineral tonnage & mineral stock calculation.
Volume of cutting and embankment, volume and weight of coal and mineral, volume of water in pit calculation, Reserve calculation.
Modern instruments in surveying: Electronic Distance Measurement (EDM). Geodimeter, Tellurometer. Electro tape. Total Station, stereoscope ;- principles of working, type ,construction & application.

Module 4

Principles of Field Astronomy: The celestial sphere. Zenith, Nadir, Poles, Equator.Observer‟s location on earth.Hour-Angle-Equator System.Azimuth and altitude.Relation among Latitude, Altitude and Declination.Astronomical Triangle.
Global Positioning System: Theory and applications in mine surveying. Terrestrial and aerial photogrammetry. Finding height and distance of ground points from photographs, scale of a vertical photograph, photographs versus maps
Statutory Requirements: Mining plans and sections. General requirement, conventional symbol used for preparation of plans and sections. Statutory requirements under Mine Regulations.Preparation and preservation of plans and sections. Representation of geological and other features on mine plans and sections, surveyoffice

TEXT BOOKS

1. William Wesely Staley, Introduction to Mine surveying, Stanford UniversityPress
2. B.C. Punmia, Surveying Vol. III –12th edition, Lakshmi Publications,1994.
3. T.P.Kanetker and S.V. Kulkarni, Surveying and leveling Vol I and II, VidyapithGrihanPrakashan,Pune.

REFERENCE BOOKS

1. FedrickWini Berg, Metalliferous Mine Surveying, 2nd edition,Mining Publications, London,
2. Ghatak, Mine Surveying Vol. I, II, III, 5th edition, Coal Field Publishers,1996.
3. V. Borsheh and Komponiets, Mine Surveying, Mir-Publishers,1989.
4. Jawahar Lal Sharma, A Text Book of Advanced Surveying C.B.S. Publishers and Distributors, 1985.
5. Ghosh, Mine Surveying, Lovely Prakashan Pub.,Pune
6. Statham I.C.F, Coal Mining Practice Vol IV., Pilgrim City Books,U.K
7. Raymond E.Davis, Francis S. Foote, J.M.Anderson and E.M.Mikhail, Surveying Theory and Practice, Land Surveyors Pub.,1997

MN. 6.7 - SURVEY CAMP/PROJECT

Course Objective: The most important pillar of learning is "DOING". Mining Engineer should be very conversant with the actual works of surveying, which this survey camp/project aims at.

Instructional Objective: The students will have hands on experience on performing survey works commonly carried out in mines.

Teaching Scheme: The camp or project work will be organised during vacation after V semester examinations for small duration of few days. The class shall be divided into batches of 4 or 5 students and one teacher needs to accompany the students to identify the project work. Students may camp at the mines or elsewhere or commute daily. Notional teaching scheme: 4 hrs /week Practical for guidance in preparation of report.

Examination Scheme:

Sessional: 25 Marks

POSSIBLE TOPICS (Suggestive)

1. Preparing topographical map of given area withcontours.
2. Designing a Foot Ball Ground byleveling.
3. Projecting a road of given gradient.
4. Surveying an existing road and exploring possibility ofwidening.
5. Calculation of the capacity of mine reject disposal at a hillslope.
6. Project diversion of Nallah as perneed.
7. Calculating the volume and tonnage of overburdendump.
8. Marking curvature for a mineroad.

Note: The Project Report should be attached with field book, calculation sheets, plans/drawings etc.

MN.7.1 - MINE ENVIRONMENT - II

Course Objective: Mine Ventilation and illumination needs to be planned and executed such that the underground environment is comfortable and healthy for the people to work.

Instructional Objective: The course enables the students to design the best ventilation system to provide most economic and comfortable underground environment. It also covers regular monitoring of the underground environment.

TeachingScheme:
Lecture:3 Hrs/week
Practicals:2Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Air flow through mine openings: Fundamentals of air flow, Reynolds number, laminar and turbulent flow, pressure losses due to friction and shock resistance, resistance of airways:- laws of mine air friction, co-efficient of friction, resistance of roadways in series and parallel, air leakages, characteristic of airway and mine, Equivalent Orifice, Economic design of an airway; Distribution of air and flow controldevices.

Auxiliary Fan and Booster Fan: Methods of ventilation for narrow headings, contra-rotating axial flow fan, rigid and flexible ducts, installation of booster fans, neutral lines, critical pressure, relevant coal mine regulation.

Module 2

Ventilation Survey in Mines: Ventilation standards, Ventilation systems, Central and Boundary Ventilation system, combined system of ventilation; Instruments required for ventilation survey, pressure survey and quantity survey; Calculation of pressure and quantity requirements; Analysis of a simple ventilation system using Hardy-Cross method, monitoring of mine environment; Duties and responsibilities of Ventilation officer, CMR 1957 regulations 32A, 42A (Duties and responsibilities of Ventilation officer), Mineregulations:
130 (Standard of ventilation), 136A (Velocity of air current), 145 (Determination of percentage of inflammable gas and of environmental conditions) and corresponding regulations of MMR 1961.

Module 3

Design of Mine Ventilation Systems: Basic Principles of ventilation design, steps in ventilation Design. Air Distribution with different mining systems, Design of ventilation systems for Board and Pillar and Longwall methods, Design of ventilation systems for

various metal mining methods; Computer applications in Ventilation design. Analysis of ventilation cost.

Module 4

Mine Illumination: Physics of Light; Light measuring techniques and instrumentation, Physiological requirements for human vision, Illumination Standards for Opencast mines, lighting arrangements for surface, Illumination standards in underground mines, Electric cap lamps, their maintenance and examination, lamp room design and organisation, Lighting from mains, Underground Coal and metal mine illumination, illumination survey, legislations related to Illumination survey.

PRACTICALS / ACTIVITIES (Suggestive):

1. Measurement of air velocity using anemometer and calculation of airflow.
2. Determination of Air velocity using Pitottube.
3. Study of various methods for Air Velocity Measurement inMines
4. Comparing humidity and cooling power based on readings of Hygrometer & Kata Thermometer.
5. Designing a ventilation network involving multiple Bord& Pillar panels and determining the distribution of air based on givendata.
6. Designing a ventilation network involving four Longwall faces and determiningthe distribution of air based on givendata.
7. Calculation of booster fan capacity based on givendata.
8. Study of ventilation systems for various metal miningmethods.
9. Measurement of light intensity and its correlation with distance fromsource.
10. Design of lighting requirement for the main haulage roadway of amine.

It is mandatory to perform eight Practicals / Activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. D. J. Deshmukh, Elements of Mining Technology Vol. II, Denett& Co.,2011
2. L. C. Kaku, Numerical Problems on Mine Ventilation, Lovely PrakashanDhanbad, 2008.
3. V. S. Vutukuri and R. D. Lama, Environmental Engineering in Mines, Trans Tech Publishers,2010
4. H. L. Hartman, Mine Ventilation and Air Conditioning, Wiley Publication,1999.
5. G. B. Mishra, Mine Environment and Ventilation, Oxford University Press,2002.

REFERENCE BOOKS

1. A. Skochinsky and Komorov V., Mine Ventilation, MIR Pub., Moscow, 1969.
2. D. Penman, J. S. Penman, The Principles and Practice of Mine Ventilation,Charles Griffin,1947.
3. H. Rabia, Mine Environmental Engineering, Entrac Software Pub,1988.
4. M. J. McPherson, Subsurface Ventilation and Environmental Engineering,Chapman & Hall Publication, London,1993.

WEB REFERENCE:NPTEL course

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MN.7.2 - MINE DISASTER MANAGEMENT

Course Objective: Disaster Management has become a highly specialised subject today. There is well established management system for mine disasters, which should be fully understood by mining engineers.

Instructional Objective: The course enables the students to understand the likely disasters in mining, the established norms of disaster preparedness and management as per Mine Regulations and Rules.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction to Disaster Management: Definition; Types of disasters- Natural such as Landslides, Cyclones, Earthquakes, floods, Tsunami; Manmade such as chemical, biological and nuclear; Examples of major disasters in the recent past; Disaster preparedness; Disaster response and mitigation; Rehabilitation, Reconstruction and recovery.

Major provisions of Disaster Management Act, 2005; Introduction to Mine disasters- Fire, explosion and Inundation.

Module 2

Spontaneous Heating: Mechanism, causes, detection, Incubation period, Crossing Point Apparatus, Grahams Index; monitoring and control of spontaneous heating in underground mines, on surface and in coal stacks; Incubation period; Preventive measures.

Fires: Classification of fires, Detection, prevention and control of underground fires; Fire fighting and inertization; fire fighting plan; fire extinguishers; fire stoppings; localization and ventilation control in fire fighting, dynamic pressure balancing; Study of atmosphere behind sealed-off fire areas; Methods of reopening sealed off fire areas; CMR-117 and CMR-118 for surface and underground precautions against fire. CMR-119 on action by individual in case of detection of fire; CMR-120 on equipment for firefighting.

Module 3

Fire Damp Explosions: Gassiness of Mine; Types, causes and mechanism of firedamp; Coward's Diagram; Preventive measures; Investigations after an explosion; Case histories.

Coal Dust Explosions: Types, causes and mechanism of coal dust explosion; Water spraying- Stone dusting, stone-dust and water barriers, quick barriers and triggered barriers; Localization of coal dust explosion; CMR-123 on dust control and stone dustbarriers.

Mine Inundation: Causes; Precautionary measures; Precautions to be taken while approaching old workings; Burnside boring apparatus; Design and construction of water

dams; Recovery of flooded mines; Dewatering of old working; Water blast: dangers and precautions.

Module 4

Mine Rescue and Recovery work: Different types of rescue equipment including self-rescuer; Mine regulation on rescue apparatus; Test on rescue apparatus: Rescue stations; Recovery and first-aid appliances; Training of personnel and organization of rescue station; Rescue and recovery work in connection with mine disasters; Fresh air base; CMR-125 on recovery and exploratory work; Main provisions of Mine Rescue Rules.

TEXT BOOKS

1. V. S. Vutukuri and R. D. Lama, Environmental Engineering in Mines, Trans Tech Publishers,2010
2. M. A. Ramulu, Mine Disasters and Mine Rescue. Oxford and IBH Publishers,1991.
3. D. J. Deshmukh, Elements of Mining Technology Vol. II, VidyasewaPrakashan, Nagpur, 2011.

REFERENCE BOOKS

1. The Mine Rescue Rules, Lovely Prakashan,Dhanbad
2. Classified Circulars by DGMS,Dhanbad
3. L. C. Kaku, Fires in Coal Mines, Oriental Publishers, 2nd Edition,1985
4. Coal Mine Regulations - 1957
5. S. P. Banerjee, Spontaneous Combustion of Coal and Mine Fires, Taylor & Francis,1985
6. M. J. McPherson, Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London,1993.

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MN.7.3 - MINE ENVIRONMENTAL MANAGEMENT

Course Objective: Environmental impact has emerged as one of the biggest issues concerning the mining industry. Environmental Management has to be given due consideration right from the planning to the closure stage of the mine.

Instructional Objective: The course enables the students to understand the environmental and social aspects which have to be considered in order to ensure a holistic approach towards project planning and execution.

TeachingScheme:	**ExaminationScheme:**
Lecture:3 Hrs/week	Theory (3 Hours): 100Marks
Practical:2Hrs/week	Sessional: 25Marks
Tutorial:1Hr/week	Oral: 25Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Man and Mine Environment: Changes of social environment caused by mining: Socio-economic factors; Occupational health hazards due to mine dust, poor lighting, ventilation, noise and vibration. Land Degradation, Textural classification and properties of soil. Visual Impact and landscape planning.

Assessment of Environmental degradation.Environmental crisis and action strategies for sustainable development.Environmental awareness.Introduction to resettlement & rehabilitation plan.Main provisions of Land Acquisition Act, An understanding on National Rehabilitation and Resettlement Policy, 2007.

Module 2

Air Pollution: Sources, ill effects, measurement and monitoring, standards: Preventive and mitigating measures. Dust in mines: Dangers, formation, prevention and suppression. Wind rose diagram, Calculation of Ground Level Concentration of air pollutants; Dust sampling apparatus, their construction and applications. Main provisions of The Air (Prevention and Control of Pollution) Act, 1981.

Water Pollution: Water quality standards; Water pollution Acts; Water Quality Criteria; Water Pollution in Mining Areas; Water Management; Water Pollution and Management strategies for controlling seepage and run-off. Acid Mine Drainage- Sources, mechanism of formation and ill effects; Preventive and mitigating measures. Alkaline Mine waters.Control of Ground water pollution and depletion.Ground water recharging techniques.Main provisions of The Water (Prevention & Control of Pollution) Act, 1974.

Module 3

Land Reclamation: Introduction about reclamation, land use pattern in India, types of reclamation, reclamation plan, content & standards of reclamation, cost of reclamation, statutory provision on afforestation.

Noise and Vibration Control: Fundamentals of Noise, Sources and measurement of noise; Noise Impacts- Auditory effects, physiological effects, effect on task performance, other effects. Noise Impact Index assessment .Preventive and mitigating measures. Blast Induced Vibration, ground vibration prediction, vibration standards, vibration control, noise and overpressure. Main provisions of The Noise Pollution (Regulation and Control) Rules, 2000.

Environmental planning: Environmental planning procedures, types of permits & approvals required for mining projects, Environmental policies.

Module 4

Environmental Impact assessment: Environmental Impact Assessment, EIA methodology, legislative requirements. Contents of EIA documents. Environmental Audit: Definition, purpose, types of audits, procedure, outcomes of environmental audits. Important notifications issued by Ministry of environment and forest, The Wildlife (Protection) Act-1972, National Conservation Strategy-1992. Forest (Conservation) Act 1980 and Forest Conservation Rules 1981 related to Mining. Main provisions of Environmental Protection Act1986.

Environmental Economics: Environment as a capital, Environmental economics, Economic policies and environment. Valuation Techniques, Cost benefit analysis. Concept of carbon trading; Corporate Social Responsibility: Role, Implementation & Societal Benefits.

PRACTICALS / ACTIVITIES (Suggestive):

1. Study of Occupational health hazards and their remedialmeasures.
2. Measurement of dust contents with the help of dustsampler.
3. Sound level meter and measurement of noise level produced by various mining machineries.
4. Mine visit for study of Reclamation of dumps for mechanized opencastmines.
5. Collection of various field data and their evaluation for preparation of EMP ofmines.
6. Measurement of vibrations produced in mines byseismograph.
7. Measurement of pH value & turbidity of water samples collected from mine discharge.
8. Preparation of EIA from givendata.
9. Case study on Acid minedrainage.
10. Case study of reclamation and valleyfilling.

It is mandatory to perform eight Practicals / Activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. N. C. Saxena, Gurdeep Singh, Rekha Ghosh, Environmental Management in Mining Areas, Scientific Publishers,2002.
2. Larry W. Canter, Environmental Impact Assessment, McGraw-Hill Education (India) Pvt Limited,1996.
3. R. K. Suri, *et al*, Mining Environment and Forests, Soc. of Forest & Environmental Managers,1996

REFERENCE BOOKS

1. Karlheinz Spitz, John Trudinger, Mining and the Environment: From Ore to Metal, CRC Press,2008.
2. Bernd Lottermoser, Mine Wastes: Characterization, Treatment and Environmental Impacts, Springer,2010.
3. The Environment Protection Act –1986
4. Earle A. Ripley, Environmental Effects of Mining, CRC Press,1995.
5. B. B. Dhar, Mining Environment, Taylor & Francis,1996

WEB REFERENCES

1) EPA 1986:envfor.nic.in/legis/env/env1.htm
2) Land Acquisition Act:http://dolr.nic.in/Acts&Rules/LandAcquisitionAct1894.htm
3) National Rehabilitation and Resettlement Policy, 2007: http://www.dolr.nic.in/NRRP2007.pdf
4) Air (Prevention and Control of Pollution) Act, 1981: http://envfor.nic.in/legis/air/air1.html
5) Water (Prevention & Control of Pollution) Act, 1974 http://www.moef.nic.in/legis/water/wat1.html
6) The Noise Pollution (Regulation and Control) Rules, 2000: http://envfor.nic.in/legis/noise/noise.html
7) Wildlife Act- 1972:http://envfor.nic.in/legis/wildlife/wildlife1.html
8) National Conservation Strategy-1992: http://envfor.nic.in/sites/default/files/introduction-csps.pdf
9) Forest Conservation Act 1980:http://envfor.nic.in/legis/forest/forest2.html
10) Forest Conservation Rules 1981:http://www.envfor.nic.in/legis/forest/forest3.html

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ELECTIVE I

MN.7.4.1 - ROCK FRAGMENTATION ENGINEERING

Course Objective: Rock fragmentation is primary operation in hard rock mining. The resulting fragmentation exerts a strong influence on the efficiency and the cost of the subsequent unit operations. Considering the trend and scope of surface mining, this course is designed to meet various requirements of blasting.

Instructional Objective: The course enables the students to apply their knowledge on rock fragmentation, particularly on blast design and evaluation, in surface mining.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Explosive-rock interaction: Mechanisms of rock fragmentation by blasting. Energy partitioning during blasting.Emerging trends in explosives and bulk loading systems.Emerging trends in initiating systems, analysis of case studies of surface blasting with electronic detonators.

Module 2

Blasting in Surface Mines: Controllable and non-controllable factors in rock blasting, Concept of optimal fragmentation, muck pile profiles and their influence on loader productivity. Blast design approaches for surface mines. Fragmentation prediction approaches and KUZRAM model. Software for surface blast design and analysis.Alternative methods for rockbreakage.

Module 3

Blast monitoring: Tools and techniques for pre-blast, in-blast and post-blast monitoring; application of high speed videography for burden movement and stemming performance; image analysis techniques for measurement of rock fragmentation by blasting; Instrumentation, field recording and analysis of In-the-hole velocity of detonation measurements.

Module 4

Blast damage and environmental impacts: Rock mass damage and its implications; Methods to assess blast damage. Control of blast damage using special techniques like line drilling, smooth blasting and pre-splitting.

Instrumentation and software for vibration and air overpressure monitoring and analysis. Various PPV predictor equations; Fast Fourier Transform Analysis for frequency; Projectiles theory based prediction of flyrock. Control of ground vibrations, air overpressure and flyrock; Signature hole method for vibration control.

TEXT BOOKS

1. G. K. Pradhan, Explosive and Blasting Technology, Mintech Publications,Bhubaneshwar
2. Bhandari, Blasting Engineering operations,Elsevier
3. E. Lopez Jemino, C. Lopez Jeminino, and Ayala Carced, Drilling and Blasting of Rocks, Taylor & Francis,1985.

REFERENCE BOOKS

1. C.J. Konya and E.J. Walter, Surface Blast Design, Prentice Hall, NewJersy.
2. S.K. Das, Surface Mining Technology, Lovely Prakashan, Dhanbad,1994.
3. D.J. Deshmukh, Elements of Mining Technology, Vol. I, Central Techno Pub, Nagpur, 2011.
4. C.J. Konya, Rock Blasting and Overbreak Control, Precision Blasting Services, Montiville,Ohio.
5. G.B. Clark, Principles of Rock Fragmentation, John Wiley and Sons, New York,1987.
6. N. R. Thote& G. K. Pradhan, Surface Mine Blast Evaluation, MINTECH Publications, Bhubaneswar, India,2010.

WEB REFERENCES

1. http://arblast.osmre.gov/
2. http://ethesis.nitrkl.ac.in/34/2/10505029.PDF
3. http://hkieged.org/download/seminar/blastingcontrol.pdf
4. https://www.isee.org/

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ELECTIVE I
MN.7.4.2 - UNDERGROUND SPACE TECHNOLOGY

Course Objective: Underground excavation is necessary for mineral extraction. It has become necessary to go below ground for construction of various infrastructural facilities also due to paucity of space on the surface and otherreasons.

Instructional Objective: The course enables the students to critically assess and understand different tunnel construction techniques for all types of tunnels such as metro, road, rail tunnels and utility tunnels. The course also covers construction of various underground space utilities.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction: Philosophy of tunnelling scope of tunnelling for mining engineers, historical context, tunnel cross-section terminology.

Site Investigation: Site reconnaissance; Ground investigation-Intrusive techniques and Non-intrusive techniques such as seismic methods, bore hole geophysical logging, cross-hole seismic techniques. Laboratory tests-Quality class test for soil, Uniaxial test, consistency of silt and clays, Triaxial test; Ground characteristics/parameters-influencing of layering on modulus of elasticity, squeezing and swelling ground; Ground parameters for tunnel design. Ground classification based on RQD, RMR,Q-Technique; Key information for tunnel design.

Module 2

Preliminary analysis for the tunnel: Stress pattern in ground, Stability of soft ground, coefficient of lateral earth pressure, preliminary analytical methods-bedded beam spring method, continuum method and tunnel support resistance method; Preliminary Numerical modelling-Modelling the tunnel construction in 2D and 3D.

Ground improvement techniques and lining system: Ground improvement and stabilization techniques- ground freezing, lowering of ground water table, grouting, ground reinforcement, forepoling, face dowels, roof pipe umbrella, compensation grouting and pressurize tunnelling; Tunnel lining system-design requirement, sprayed concrete, ribbed systems, segmental linings, in-situ concrete linings and fire resistance of concrete linings.

Module 3

Tunnel Construction Techniques: Introduction, Open face construction without shield-timber heading, open face tunnelling with alternative lining; partial face boring machine, tunnelling shields; tunnelling boring machine- gripper tunnel boring machine, sealed tunnel boring machines, general observations for hard rock tunnel boring machines; tunnels boring machine in soft ground- slurry tunnelling machines, earth pressure balancing machines, multimode tunnel boring machines, choice of tunnel boring machine.

Tunnelling by Drilling and Blasting: Drilling, charging, stemming, detonating; Ventilation; Marking and support; Full face method, Heading & Benching methods of excavation; Controlled blasting; Major Problems in drill blast tunnel method.

Special Methods of Tunnelling: NATM tunnelling method- New Austrian tunnelling method, LaserShell Technique; Cut and Cover tunnels-construction methods, design issues, excavation support method for the side of excavation; Immersed tube tunnels- stages of construction, type of immersed tube tunnels, immersed tube tunnel foundation and settlements, joint between tube elements, Analysis and design; Jacked Box tunnelling – method and key components; Pipe Jacking and micro tunnelling- construction process, maximum drive length for pipe jacketing; horizontal directional drilling.

Module 4

Underground space construction: Need for Underground Space: Congestion driven needs, storage of materials; Engineering Utilities; Nuclear Waste Disposal; Strategic Utilities; Excavation issues and methods of large and deep caverns - unit operations, different equipment, types of rock pressure and methods to deal, roof and wall supports.

Underground Storage of Grain & Food: their advantages, disadvantages, underground cold storage and cellar for foods and beverages.

Hydropower tunnels and caverns: Basic Principles, Layout of power house caverns & desilting chambers.

Underground storage for LPG, LNG, Crude and its products – basic principles; Nuclear Waste Disposal: Conditions, effect of radioactivity and heat on surrounding rock, conceptual design of a nuclear waste disposal facility; Defense facilities: Bunkers & shelters, navy bases, air force hangers.

Case Studies: Hydel, Crude Oil, LPG and Nuclear facilities; Preparation of different conceptual plans of underground space applications.

TEXT BOOKS

1. David Chapman, Nicole Metje and Alfred Stark, Introduction to TunnelConstruction, CRC Press,2013.
2. Ernest D. Wahlstrom, Tunneling in Rock, Elsevier;1973.
3. Ray Sterling and Jian Zhao, Tunnelling and Underground Space Technology,Elsavier.

REFERENCE BOOKS

1. Proceedings of International Conference on Underground Space Technology and the8th Asian Regional Conference of IAEG 17–19, January, 2011, Bangalore, India.
2. Proceedings of World Tunnel Congress, Seoul, AITES-ITA2006.

3. Proceedings of the International Conference on Tunnelling and UngroundSpace Technology, WTC2012, 18-23 May 2012,Bangkok.
4. Proceedings of the International Conference on Urban Underground Space and Tunnelling 20-22 November 2013, HongKong.

WEB REFERENCE

1. http://www.undergroundspace.in/
2. http://areeweb.polito.it/ricerca/lame/en/documents/paper%20ACUUS%202007_2.pdf
3. http://actamont.tuke.sk/pdf/2007/s1/30kleta.pdf
4. http://www.ctta.org/FileUpload/ita/2008/data/pdf/04.PDF

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ELECTIVE I
MN.7.4.3 – PETROLEUM ENGINEERING

Course Objective: On-going growth in worldwide energy consumption is exponentially increasing the demand for petroleum products. Graduates with range of skills in engineering and geoscience disciplines are in high demand.

Instructional Objective: The course provides basic knowledge of geology, exploration, evaluation, development, and recovery of hydrocarbons.

TeachingScheme:
Lecture: 3Hrs/Week
Tutorial: 1Hrs/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Petroleum: Its different states of natural occurrence, chemical composition and physical properties of crudes in nature; Origin of petroleum (Organic and Inorganic theories); Bitumen and Kerogen.

Reservoir Rocks: Classification of reservoir rocks – fragmental reservoir rocks and chemical reservoir rocks. General attributes and petrophysical properties; Porosity and Permeability; control of Sediment character on petrophysical properties.

Migration of oil and gas: Geologic framework of migration; primary and secondary migration; Geologic factors controlling hydrocarbon migration; Forces responsible for migration, Migration routes and barriers.

Hydrocarbon traps: Definition; classification of hydrocarbon traps – structural, stratigraphic and combination; Cap rocks – definition and general properties.

Module 2

Exploration Methods: Surface indications of subsurface oil and gas accumulations. Regional Petroleum Prospecting – Magnetic, Gravity and Seismic, remote sensing, geochemical; Procedures for data Collection, Correction, Interpretation; Hot spots for oil and gas.

Reserve Estimation: Classification of Reserves (UNFC/SPE), Reserve Status Categories, Methods of Reserve Estimation: Analogy, Volumetric, Material Balance, Model Studies, Production Decline Curves; quality of reserve estimates.

Module 3

Drilling: Types of Drilling, Outline of Drilling equipment; drilling complications and mud importance; Deep hole drilling. Introduction to Offshore drilling technology, Fishing tools and Techniques.

Drill Fluids: Drilling Fluid Characteristics: Basic functions, properties, maintenance and treatments of drilling fluids. Classification, Types and applications of Drilling Fluids: Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids.

Casing and Cementation: Objectives of cementing, oil well cements, Classification of cement, Cementingequipments. Cementing Methods: Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice. Deep well cementing, Characteristics of good quality cementation.

Module 4

Well completion and production: Logging operations, Logging methods, Interpretation; Oil recovery techniques. Well equipment: Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines. Introduction to Well completion: Systems, types and applications. Introduction to well servicing and stimulation system – objectives and applications; Production problems.

Introduction to Processing in Oil Fields: GGS/CTF – layout, sequential treatment, separation, storage and transportation of petroleum. Basics of crude oil refining and Natural gas processing.Introduction to petrochemicals.

TEXT BOOKS

1. Bjorlykke, K. 1989. Sedimentary and Petroleum Geology. SpringerPubl.
2. Chaudhuri, U. R. 2011. Fundamentals of Petroleum and PetrochemicalEngineering
3. Levorsen, A. I. 2004. Geology of Petroleum. CBSPubl.

REFERENCE BOOKS

1. F. K. North, 1985. Petroleum Geology. Allen &Unwin.
2. R.C. Shelley, 1997. Elements of Petroleum Geology. AcademicPress
3. Gatlin, C. 1980. Petroleum Engineering: Drilling and Well Completion. Prentice Hall. USA

WEB REFERENCE

1. www.icheh.com/Files/Posts/Portal1/Petroleum%20and%20natural%20Gas%20Handbooks-vol2-(part-1).pdf

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ELECTIVE II
MN.7.5.1 – GEODETICSURVEYING

Course objective: Modern Technology has developed new approaches in surveying which are extensively used in the industry to obtain accurate data foranalysis.

Instructional objective: The subject enables students to use modern tools in surveying.

TeachingScheme:	**ExaminationScheme:**
Lecture:3 Hrs/week	Theory (3 Hours): 100marks
Tutorial:1Hr/week	Sessional: 25Marks
Practical:4Hrs/week	Oral: 50Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Geodetic Surveying: Definition, importance, objectives, concept of geoid and reference spheroids, co-ordinate systems, geoid undulation, deflection of vertical, datum-horizontal & vertical.

Triangulation & Trilateration: Network & strength of figures, field work-selection of stations, Importance of accuracy in base line measurement, measurement by different methods & satellitestations.

Traversing: Theory and principles associated with traversing, Balancing of traverse, Numerical examples related to traversing and joins.

Module 2

Modern Surveying Instruments & Techniques: Principles of EDM-electronic distance measurement technique, Electronic theodolite & total station; Concept and definition of Digital Terrain Models (DTM); Use of Auxiliary Telescope and its importance. LIDAR (Light detection and ranging) - introduction, concept, overview, structure, classification, application and dataprocessing.

Module 3

Subsidence Monitoring: Introduction, terminology, subsidence parameters, subsidence prediction methods; Precise levelling, Monitoring of small ground movements & data analysing techniques;

Global Positioning Systems (GPS): Principle of GPS measurements, various applications of GPS; adjustment/calibration and care of Differential GPS; Various modes of observations; transformation from one system to another system of coordinates, GPS data processing.

Signal structure of GPS, pseudo range & phase observables, recent advances- such as GLONASS, Galileo & GNSS.

Module 4

Geographical Information System (GIS): Concepts, essential components, data acquisition, raster and vector data, Geo-referencing, topology and spatial relations, data storage verification and editing, database construction, database structure, hierarchical data, network systems, relational database; data manipulation and analysis; Spatial and mathematical operations in GIS, overlay, query based buffers, spatial analysis, Triangulated Irregular Network (TIN), various GIS packages and their salient features.

PRACTICALS / ACTIVITIES (Suggestive):

1. Base-line measurement in Triangulation survey by wheeler'smethod.
2. Closed surface levelling traverse with the necessary adjustments and distribution of closing error (calculation and instrument erroradjustments).
3. Closed surface traverse by using total station with necessary adjustments and distribution of closing error (direction and Bowditchadjustments).
4. Raw data download from total station in .strformat and prepare a surface plan (including contour lines) working with SURPAC &Auto-plotting.
5. Earthwork calculations using SURPAC by creating Digital Terrain Models, performing DTM Volume calculations (Cut & Fill) & Sectioning a DTM and plotting ofsections.
6. Measurement of steep slope using AuxiliaryTelescope.
7. Study and sketch of Auto level with parallel plate micrometre and precisestaff.
8. Carry out subsidence monitoring of small ground movements and distribution of closing error by preciselevelling.
9. Locate the position of a point by means of DGPS in accordance with best survey practice by performing static, rapid static, kinematic and stop & gomodes.
10. Downloading and Post-processing of DGPS data &Plotting**;**
11. Raw data download from total station in .txt format and prepare a surface plan (including contour lines) using suitable software &Auto-plotting.
12. Earthwork calculations using suitable software by creating Triangulated Irregular Network (TIN), performing TIN Volume calculations (Cut & Fill) & Sectioning a TIN and plotting ofsections.

It is mandatory to perform eight Practicals /Activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. DrSamir Kumar Das, Information Technology in Mining, Lovely PrakashanDhanbad, 1st Ed.2002.
2. S. K. Duggal, Surveying Volume-II, Tata Mc Graw Hill Publishers, New Delhi, Ed-1996.
3. W. Schofield, Engineering Surveying, Replica Publications Delhi, 5th Ed.2001.

REFERENCEBOOKS

1. T. P. Kanetkar/Kulkarni, Survey & Leveling Vol.1, 2 & 3, VidyaGrihaPrakashan, Pune.
2. Dr. B. C. Punmia/ AK Jain, Surveying Vol.1, 2 & 3, Laxmi Publications, New Delhi, 10th Ed.1989.
3. David Clarke, Plane & Geodetic Surveying, CBS Publ. & Distributors,2004

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1. www.gisdevelopment.net/turtorials/tuman006.html
2. http://www.fig.net/pub/fig2011/papers/ts05i/ts05i_isioye_jobin_4911.pdf
3. http://ftp.rta.nato.int/public/PubFullText/RTO/AG/RTO-AG-160-V21/AG-160-V21-01.pdf
4. http://www.rgs.org/NR/rdonlyres/95D99DBD-CE9B-4B89-81F3-22D12B3B976E/0/Chapter6TheGlobalPositioningSystemGPSPrinciplesandConcepts.pdf
5. http://www.tcd.ie/civileng/Staff/Brian.Caulfield/3A1/3A1%20Lecture%209.pdf
6. http://www.gisresources.com/wp-content/uploads/2013/11/Principles-of-GPS-4-13-04.pdf
7. http://web.ics.purdue.edu/~ecalais/teaching/geodesy/GPS_observables.pdf
8. http://www.nbmg.unr.edu/Staff/pdfs/Blewitt%20Basics%20of%20gps.pdf

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ELECTIVE II

MN.7.5.2 – OPTIMIZATION TECHNIQUE IN MINERAL INDUSTRY

Course objective: Normative economic decision analysis involves determining the action that best achieves a desired goal or objective, i.e. finding the action that optimizes the value of an objectivefunction.

Instructional Objective: The course equips the students in understanding the various optimization tools and their application in mineral industry.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:1Hr/week
Practical:4Hrs/week

ExaminationScheme:
Theory (3 Hours): 100marks
Sessional: 25Marks
Oral: 50Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Minimization and maximization using differential calculus, optimization of cut-off grade; Linear Programming –concepts, graphical solutions, Simplex method, primal-dual model, sensitivity analysis.

Module 2

Assignment problems-the Hungarian Method; Transportation problems in mining, Dynamic Programming, stage coach problem and their application in mining.Discrete and continuous probability distributions, stochastic process; Markov chains and its application in mining.

Module 3

Network Analysis-problems of shortest path, minimal spanning tree, maximal flow, CPM and PERT, application of network analysis in planning, scheduling the mining project; Queuing System-Basic queuing models with constant arrival and service rates, its application in shovel-dumper system.

Module 4

Genetic Algorithms, representation of design variables, objective Function and Constraints, Genetic Operators; Neural-Network based optimization in mining; Inventory model-Definition, deterministic models, probabilistic models and their application to mining.

PRACTICALS / ACTIVITIES (Suggestive):

1. Determine cut-off grade of ore in a mine.
2. Optimize cost of transportation for supplying coal from mines to variousdestinations.

3. Determine the optimal assignment of ‘m’ jobs or workers to ‘n’ machine in a mine using HungarianMethod.
4. Scheduling of production in amine.
5. Scheduling of equipment and machinery overhauls in amine.
6. Performance analysis of mining equipment using MarkovChain.
7. Determine equipment replacement policy in amine.
8. Optimize mining project completiontime.
9. Optimize shovel-dumper system in open cast mine by QueuingSystem.
10. Optimization of scheduling of drilling, blasting, loading and support operation in developmentheading.
11. Optimize drilling and blasting cost for surfacemine.
12. Determine optimum level of inventory to be maintained in amine.

It is mandatory to perform eight practicals/activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. S. S. Rao, Engineering Optimization, New Age International Publishers,Third Edition,2013.
2. Operations Research Applications by A. Ravi Ravindran(Editor),CRCPress,2009
3. Operations Research by P.K. Gupta and D.S. Hira, Chand Publication,New Delhi,2007

REFERENCE BOOKS

1. Operations Research: An Introduction by HamdyA. Taha,Macmillan Publishing Co., Indiannapolis,USA,1987
2. Operations Research by KantiSwarup, P.K. Gupta, Man Mohan, Sultan Chandand Sons, New Delhi,2010
3. Introduction to Operations Research by Billy E. Gillett,McGraw-Hill,1976

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1. mech.iitm.ac.in/nspch52.pdf
2. www.springer.com/cda/content/.../cda.../9781461417514-c1.pdf
3. *mech.iitm.ac.in/nspch52.pdf*
4. nptel.ac.in/.../IISc.../OPTIMIZATION%20METHODS/.../M1L4slides.pdf
5. http://upecen.edu.pe/ebooks/Administraci%C3%B3n/Operations%20Research%20Applications.%20A.%20Ravi%20Ravindran.pdf
6. http://www.mu.ac.in/myweb_test/MCA%20study%20material/M.C.A.(Sem%20-%20III)%20Operation%20Research.pdf

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ELECTIVE II

MN.7.5.3 – COMPUTER PROGRAMMING (OOPS) IN C++

Course objective: Information Technology is now penetrating in every field of engineering including mining. Object oriented programming offers a new and powerful way to cope with complex and repetitive tasks which are common in mining industry.

Instructional Objective: The subject indents to develop programming skills of the students in "C++" so that they can solve a variety of complex and repetitiveproblems.

TeachingScheme:	**ExaminationScheme:**
Lecture:3 Hrs/week	Theory (3 Hours): 100marks
Tutorial:1Hr/week	Sessional: 25Marks
Practical: 4Hrs/week	Oral: 50Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction to Object Oriented Programming: Principles of object oriented programming, object-oriented paradigm. Overview and Benefits; Approaches to Software Design, Evolution of the Object Model, Benefits of Object Programming, Modelling using UML:UML overview, Nature and purpose of models, Static view, Use case view, Static machine view, Activity view, Interactionview.

Module 2

C++ Fundamentals: Abstract data types (ADT), Encapsulation and information hiding, tokens, expressions, control structures, functions, Classes and Objects, Constructors and destructors.

Overloading: Function overloading, operator overloading, Overloading types, & rules, explicit & implicit type conversion operators.

Module 3

Inheritance: multiple inheritance, hybrid inheritance,

Polymorphism: Concepts of polymorphism

File & Streams: I/O streams and classes, Manipulators, Classes for file streams, file I/O operations and functions.

Module 4

Template: Template functions and classes, implementation

Exception: Exception handling: Need, Throwing mechanism, try, catch block, Introduction to the Standard Template Library: Components of STL, Containers, Algorithms, Iterators, Applications.

Graphics: Graphics functions

PRACTICALS / ACTIVITIES (Suggestive):

The practical work in this course will be based on the series of programming exercises, which will reinforce the concepts of object Oriented Paradigm (OOP). The programming will be implemented on Turbo C++ or Borland C++ Compiler. The List of Programming exercises will be based on the following constructs.

1. Input and Outputstatement
2. If statement, Switch statement, Conditional operationstatement
3. For statement, While statement, Do-Whilestatement
4. Functions, Objects andClasses
5. Arrays,Strings
6. Files andStreams
7. Pointers
8. OperatorOverloading
9. Inheritance
10. Polymorphism
11. Templates
12. Graphics

It is mandatory to perform eight practicals / activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. Object oriented programming with C++ by E Balaguruswamy, Tata McGrawHill
2. Mastering C++ by K R Venugopal, Rajkumar, T. Ravishankar – Tata McGrawHill
3. The UML Reference Manual by J.Rumbaugh etal,

REFERENCE BOOKS

1. Teach yourself C++ by Herbert Schildt,TMH
2. Programming with C++ by J. R. Hubbard (Schaum's Outlines), McGrawHill.
3. Programming with C++ by D. Ravichandran, McGrawHill.

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MN.7.6 - PROJECT (Interim)

Course objective: Application of the knowledge gained during the course of study in solving problems through new approaches is necessary to be successful in one's career.

Instructional Objective: To encourage the students to work in a group so that they will develop team and leadership qualities leading to solution of specific problems in mines.

TeachingScheme:
Practical: 4Hrs/week

ExaminationScheme:
Sessional: 25Marks
Oral : 50 Marks

Guidelines for Project Work:

1. Project can be undertaken in-house or in an industry or in a research /service organization.
2. Generally a Project batch consists of two to fourstudents.
3. The Project Synopsis should be prepared in the beginning of the term and approved by a designated departmentalcommittee.
4. The topic of the project may be in the area related to mining, or it may be multidisciplinary. It may involve investigation/ analytical study / experimental work / fabrication / Statistical study / simulation etc. it may also be field oriented. The project should be preferably being taken in the latest trends in Engineering and Technology.

Project Report:

The Project (Interim) report shall consist of the following:

a. Problemidentification.
b. Statement ofproblem.
c. Formulation of the objective and Scope of thestudy.
d. Literaturereview.
e. Methodology to beadopted.

Evaluation:

Monthly review to assess the progress of the project work will be conducted by the Guide. Mid Semester evaluation will be done by the departmental committee. Students shall submit project reports to the department and make a presentation before the committee.

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MN.8.1 - MINE PLANNING & DESIGN

Course Objective: Mine planning and design involves compilation and integration of all relevant geological, geotechnical, mining, engineering and economic data into a single document to define and describe the exploitation strategy for a particular mineral deposit within legal, financial and regulatory requirements and constraints.

Instructional Objective: The course enables the students to integrate all the activities involved in the overall mining process that will meet predetermined targets with regard to health, safety, environment, production, productivity and cost criteria.

TeachingScheme:
Lecture: 3 Hrs/week
Tutorial:2 Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction to Mine Planning: Objectives and Principles of mine planning, Mine Planning Process, Scientific and engineering approach to mine design. Strategic planning; Stages of mine planning - Long Range Planning, Short Range Planning, division of a coal field into mining blocks; Technical, Economical and environmental information required for mine planning; Techno-economics of opencast versus underground mining operations.

Module 2

Surface Mine Planning: Determination of optimum output, life of a mine and size of mine, Taylor's mine life rule, ultimate pitconfiguration. Optimum location of mine entries, Technical and economic considerations in opening up, bench formation and ultimate pit configurations; Determining Pushback Parameters, Pushback Selection/Mining Sequence, Production planning and scheduling, calendar plan, mine equipment planning, Grade control strategies, infrastructure planning. Systems of overburden removal and planning of layouts for stipulated production; Drainage Planning and Arrangement, Reclamation Planning - Planning for reclamation of mined out areas, open pits, waste dumps and tailings pond, The Detailed Mine Plan, SurfacePlan.

Module 3

Underground Mine Planning: Capacity of a Mine; Delineation of mining area; Annual output and life of the mine; Design of mine entry systems- Opening of single and multiple seams/veins at various inclinations – Type (shaft, incline or adit), number, location and design; Division of the mining area into working units on district and level pattern.

Coal Mining: Dimensions of panels and blocks; Selection of mining methods; design of coal pillars, Layout of development drives, size of panels, length, number and position of Longwall faces, layout of drainage system, production schedule and monitoring, mine economic analysis.

Non-Coal Mining: Selection of mining methods; Design of Crown pillars, Layout of development drives, Stope design, layout of drainage system, production schedule and monitoring, mine economic analysis.

Module 4

Project implementation and monitoring: Social, Legal, Political and Economic aspects of mine planning, Sources of uncertainty in mining projects; assessment of alternatives and risk. Various stages in project implementation, import of technology, Identification of activities for outsourcing, Need of Mine closure plan and R&R plan, Sources of funds, Social responsibility, Quality assurance plan, resource management, time management,. Appraisal of Mining Project, Cost profitanalysis.

TEXT BOOKS:

1. William A. Hustrulid, Mark Kuchta, Fundamentals of open pit mine planning and design, Vol I & Vol II, Elsevier,1995.
2. Hartman - Introductory Mining Engineering, John Wiley and Sons Inc.1987.
3. Jayant Bhattacharya. Principles of Mine Planning. Allied Publishers, Delhi,2003.
4. S.P. Mathur, Mine Planning for Coal, MG Consultants Bilaspur,1993

REFERENCE BOOKS:

1. S.M.E. Mining Engineering Handbook, Vol. I & II. Hartman, Society for Mining metallurgy and Exploration Inc.1992.
2. T.N. Singh, Underground Winning of Coal, Oxford IBH,1992.
3. S. K. Das, Modern Coal Mining Technology Lovely Prakashan, Dhanbad,1996.
4. R. D. Singh Principles & Practices of Modern Coal Mining, New AgeInternational (P) Ltd. Publishers, 1997,
5. B. Boky, Mining, Mir Publishers,1967.
6. Raj, K Singhal (Ed.) Mine Planning and Equipment Selection, A. A. Balkema,1988.

WEB REFERENCE

1. http://ibm.nic.in/IBM_Manual_miningplan.pdf
2. http://ibm.nic.in/manual%20mining%20plan.pdf
3. http://ibm.nic.in/mineclosuregl.pdf
4. http://ibm.gov.in/mpmspro.htm
5. http://ibm.nic.in/reportch7.8.pdf
6. http://researchspace.csir.co.za/dspace/bitstream/10204/1523/1/COL814.pdf

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MN.8.2 - MINE SAFETY & LEGISLATION

Course Objective: Global know-how in safety and occupational health issues is of prime concern in mining. Directorate General of Mines Safety is the regulatory body for formulation of relevant rules and regulation in this regard for mining industry. Every Mining Engineer should be well versed in the statutory requirement of safety, health andhygiene.

Instructional Objective: The course enables the students to understand various acts, rules and regulations applicable to the mineral industry. The course covers studies on mine accidents, diseases and mine safety.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:1Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Health and Safety: Awareness on Health Safety and Environment policy, Definition of health and safety, Health and Workmen Comfort conditions; Occupational diseases - their causes, nature and prevention.

Management's Role in safety – Safety organisation mines, role and responsibility of safety officer, Risk Analysis; Fault tree analysis- Methodology, symbols, Boolean techniques, qualitative and quantitative analysis; Creating and maintaining safety awareness; Safety campaign; Safety Audits.

Module 2

Classification of accidents - Statistics, causes, prevention and corrective action; Personal protective equipment; Costs of accidents; Accident investigations, Accident report by mine authorities; Accident proneness; frequency and severity of accident; ZAP and MAP; Job safety analysis; Court of Enquiry and Accidents enquiry reports; Vocational training as an aid to safety and productivity.

Module 3

Mines Act: Provisions of Mines Act 1952 with respect to safety - Medical appliances (Sec. 21), Power of inspector in case of danger (Sec. 22, 22a), Notice of accidents (Sec.23), Appointment of court of enquiry (Sec. 24), Notice of certain diseases (Sec. 25, 26), Publication of reports (Sec. 27);

Mines Rules 1955: Medical examination of persons employed in mines; Workman inspector and safety committee; health and sanitation provisions; first aid and medical appliances.

Mine Vocational Training Rules: Various training schemes; arrangement for refresher training; training centres; qualifications, duties and responsibilities of training officers; stipend andcertification.
Indian Electricity Rules regarding usage of electrical power in mines.

Module 4

Mine Regulations: Coal Mines Regulation 1957 – Notices of accidents, disease (Reg. 9, 10,), Appointment of Safety Officers, Officials, Competent persons (Reg.31a, 36), Duties of Safety Officer (Reg.41a), Fencing and gates (Reg. 68, 84, 97, 112, 187), Avoidance of dangers (Reg.114), PPE's (Reg.191), Information about sickness (Reg.192), Place of accident (Reg.199), Emergency plan (Reg.199A); Similar provisions under Metalliferous Mines Regulations1961.
Recent technical circulars issued by DGMS on safety.

TEXT BOOKS

1. P. Seshagiri Rao. Law of Mines & Minerals. Published by Asia Law House, Hyderabad .2006
2. Rakesh & Prasad. Legislation in Indian Mines Vol. I & II. Pub: Mrs. Asha Lata, Varanasi, Reprinted2002.
3. Kejriwal B. K. Safety in Mines, Gyan Khan Prakashan1994.

REFERENCE BOOKS

1. Raj Kishore Ojha, Industrial SafetyManagement
2. L M Deshmukh, Industrial Safety Management, McGraw Hill Education,2005
3. Classified Mine Circulars Issued by DGMS (Compiled) National Council of Safety in Mines, Dhanbad.
4. Relevant Act. Rules and Regulations, Published by Govt. ofIndia
5. Mines Act 1952, Lovely Prakashan,Dhanbad.
6. Coal Mines Regulation 1957,www.dgms.net/cmr.pdf
7. Metalliferous Mines Regulations 1961www.dgms.net/mmr.pdf
8. Mines Rules 1955, Lovely Prakashan,Dhanbad.
9. The Mine Rescue rules, 1986, Lovely Prakashan,Dhanbad.
10. The Indian Electricity rules 1995, Lovely Prakashan,Dhanbad.
11. The Payment of Wages Act 1936, Ram Narain Lal Beniprasad,1995.
12. Vocational Training Rule, Lovely Prakashan,Dhanbad.
13. The Workmen's Compensation Act 1923, Ram Narain Lal Beniprasad,Allahabad 1995.

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ELECTIVE III
MN.8.3.1 - ROCK SLOPE ENGINEERING

Course Objective: Slope instability is a major problem not only in mining but also in all man-made and natural slopes. Resolving the slope failure problem is important to prevent major hazards.

Instructional Objective: The course develops ability in design and analysis of rock slopes for safe and economic operations considering the geological and geotechnical properties of soil and rock materials, and designparameters.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:2Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Rock Slope Engineering: Types of slope failure; Principles of rock slope engineering; Parameters related to slope stability; Slope stability problems in opencast mines; Consequences of slope failures.

Geological factors Affecting Slope Stability: Shear strength of intact rock; Shear strength of discontinuities; Scale effects and rock strength, Friction angle of rock surfaces, Shearing on an inclined plane, Shear strength of rock masses by back analysis of slope failure, Hoek–Brown strength criterion for fractured rock masses, Generalized Hoek–Brown strength criterion, Mohr–Coulomb criterion, Estimation of rock mass strength, disturbance factor; Effect of slope geometry, equipment loading, dynamic loading, any other external loading andtime.

Module 2

Effect of ground water on rock slopes: Hydraulic conductivity and flow nets, Ground water flow in fractured rock, Measurement of water pressure, Field measurement of hydraulic conductivity, Influence of water on shear strength of discontinuities; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.

Modes of Slope Failure: Mechanics of slope failure – plane, wedge, circular, toppling, buckling, block and key block failures. Examples of pit slope and dump slope failures.

Module 3

Plane failure: General conditions for plane failure, Plane failure analysis, Critical tension crack depth and location, Critical slide plane inclination, Analysis of failure on a rough plane.

Wedge failure: Definition of wedge geometry; Analysis of wedge failure; Wedge analysis including cohesion, friction and water pressure; Wedge stability charts; Example of wedge analysis charts; Comprehensive wedge analysis.

Circular failure: Conditions for circular failure and methods of analysis; Circular failure charts; Location of critical slide surface and tension crack; Examples of circular failure analysis; Detailed stability analysis of circular failures - method of slices.

Toppling failure: Types of toppling failure; Kinematics of block toppling failure; Limit equilibrium analysis of toppling; Stability analysis of flexural toppling.

Module 4

Analysis and Design of Pit Slopes and Waste Dumps: Analytical, deterministic, probabilistic approaches and numerical analysis of rock and soil slopes; Slope analysis and factor of safety using limit equilibrium methods; Application of RMR/RSR/SMR classification in slope stability evaluation; Sensitivity analysis, Load and Resistance Factor, Stereographic analysis of structural discontinuities, Pole plots and contour plots, Pole density, determination of possibility and type of failure based on structural analysis.

Remedial measures for stabilizing slopes: Stabilisation and strengthening of slopes - Slope geometry configuration; wall control blasting techniques; Slope drainage systems and practices; rock reinforcement.

Field instrumentation and monitoring: Instrumentations for monitoring slope movements. Surface monitoring methods; Crack width monitor; Global positioning system; Sub-surface monitoring methods- Time–domain reflectometry; Time–movement and time–velocity plots.**Mine Regulations related to rock slopes in surface mining.**

TEXT BOOKS

1. Hoek, E., and J.W. Bray, Rock Slope Engineering, Institute of Mining and Metallurgy, 1981.
2. R. K. Goeland Bhawani Singh, Engineering Rock Mass Classification: Tunnelling, Foundations and Landslides, Elsevier Publishers,2011.
3. M. G. Anderson and K. S. Richards (Eds), Slope stability—geotechnical engineering and geomorphology, Wiley, Chichester,1987.

REFERENCES

1. Brawner, C.O., and V. Milligan, Stability in Open Pit Mining, SME,1971.
2. Brawner, C.O., Stability in Surface Mining, SME,1982.
3. Priest, S.D., Hemispherical Projection Methods in Rock Mechanics, George Allen & Unwin,1985.
4. Coates, D.F., Pit Slope Manual, CANMET, 1977. DGMS (Tech.)(S&T) Circular 2 dated 20/06/2001 to prevent accident due to failure of slope in an opencastmine.
5. DGMS (Tech.) (S&T) Circular No. 02 Dhanbad, Dated 06.07.2010 regarding Design, Control and Monitoring of Pit and Dump Slopes in OpencastMines.

WEB REFERENCES:

1. http://etd.lib.metu.edu.tr/upload/12609939/index.pdf
2. http://ethesis.nitrkl.ac.in/1333/
3. http://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/aamop.pdf

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ELECTIVE III
MN.8.3.2 - GEOSTATISTICS

Course Objective: Estimation of ore reserves and their classification is the foundation for making investment decisions. Geostatistical approach provides most accurate reserve estimation.

Instructional Objective: The course aims at giving students the knowledge of geostatistics and its application.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:2Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Classical statistical distributions: Normal and lognormal, their applications in resource evaluation.

Deterministic mathematical models- Independent random model, trend with random noise, correlated random models and trend with correlated random residuals.

Geostatistics: Definition, schools of thought; stationary assumptions and regionalised variables; purpose, need and applications conditions.

Module 2

Semi-variogram and Co-variogram: Definitions, characteristics, and computation in one, two and three dimensions; various models of variogram – random model, spherical model, exponential model, Gaussian model, linear model, de Wijsian parabolic model; associated difficulties namely anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend, sill andrange.

Extension, estimation and dispersion variance: Calculation by discretisation and auxiliary functions.

Module 3

Kriging: Definition and derivation of kriging system of equations, Indicator kriging. Practice of kriging- steps and procedure. Practice of semi-variogram modelling.

Integrated geological and geostatistical system- statistical analysis, comparative analysis, geeostatistical structural analysis, trend analysis, point kriging cross validation, block kriging.

Module 4

Geostatistical Applications: Optimisation of exploration drilling, calculation of mineral inventory, establishment of grade-tonnage relations, misclassified tonnage- actual versus estimated; grade control plan, geostatistical case studies of selected mineral deposits; Application in environmental assessment.

TEXT BOOKS

1. J. M. Rendu, An Introduction to Geostatistical Methods of Mineral Evaluation (Geostatistics), South African Institute of Mining and Metallurgy,1978.
2. E. H. Isaaks and R. M. Srivastava, An Introduction to Applied Geostatistics, Oxford University Press, USA,1990.
3. P. Goovaerts, Geostatistics for Natural Resources Evaluation, Oxford University Press,1997.

REFERENCE BOOKS

1. A. J. Sinclair and G. H. Blackwell, Applied Mineral Inventory Estimation, Cambridge University publication, 2002.
2. B, D. Ripley, Spatial Statistics (Wiley Series in Probability and Statistics), Wiley-Interscience, New edition,2004.
3. Schabenberga O &Gotway C Statistical (2005) methods for Spatial Dataanalysis.
4. Pela J Dissle, Paulo J Ribeiro, Jr (2007) Model Based Geostatistics,journal.
5. Wckernagel, Ham (1998) Multivariate Geostatistical (2nd Edition)Springer.

WEB REFERENCE

1. http://people.ku.edu/~gbohling/cpe940/Variograms.pdf
2. http://people.ku.edu/~gbohling/BoiseGeostat/IntroToGeostatistics.pdf
3. http://www.pdffree-download.com/pdf-ebook/an-introduction-to-applied-geostatistics-pdf.php

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ELECTIVE III
MN.8.3.3 - SMALL SCALE MINING AND OCEAN MINING

Course Objective: Many of the minerals such as clay, sand, building stone, dimensional stones, mica etc are extracted by small scale mining and there is a need for working these mines in a systematic and scientific manner. As the minerals are abundant in the form of polymetallic nodules, ocean mining assumes a great potential in future.

Instructional Objective: The course enables the students to understand the concept of small scale mining and ocean mining, their importance, and current practices and future trends.

TeachingScheme:
Lecture:3 Hrs/week
Tutorial:2Hr/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction to Small Scale Mining: Concept of small scale mining; Small scale mines – worldwide, Indian Policy in small scale mines – practices, policies and perspectives, Problems of small scale mines – financial, legislative support, technical expertise, Environmental obligations; Safety, health and training; Environmental impacts and protection; Quality control, marketing & export ofminerals.

Small Scale Mining Resources: Classification and mode of occurrence of granite and other minor minerals; Physical, mechanical and chemical properties; Geological aspects of mining, Dimensional stone mining; Case studies of mining of minerals like sandstone, marble, beach sands, alluvial mining, mica, barytes, diamond and gemstones, etc.

Module 2

Mining of dimensional stones: Various techniques of dimensional stone mining – conventional & novel techniques, recent trends; block mining and slab mining; Manual mining; Mechanized mining – line drilling; in-situ sawing by wire saw, chain saw, portable circular saw; flame cutting.

Cutting / Sawing tools: Tool carrier – circular steel blade; steel wire rope; chain jib saw; Gang-saw; Cutting tools – diamond segments, diamond pearls / bits, tungsten bits etc.; Process of manufacture, ingredients, brazing / fitting, wearing pattern and control; Cost of cutting.

Handling of blocks and slabs: Equipment used - Derrick crane, Front loaders, Fork-Lifts, Mobile Cranes, Trucks and trailers; Hydraulicjacks.

Module3

Introduction to Marine Mining: Introduction to marine environment; development & status of ocean resources of mining in Goa, other parts of the country and worldwide; Ocean profile; Ocean floor topography; Economic exclusive zone and fundamentals of law of the sea, coastal zone & itscharacteristics.

Marine Geology And Resources: Physical and chemical properties of seawater; overview of marine mineral deposits; Deep-sea bed mineral resources; Polymetallic nodules; sulphate nodules; Chemicals from the ocean; Dissolved and undissolved mineral deposits, sea water as resource and beachplacers.

Module 4

Exploitation Of Marine Deposits: Shallow and deep sea bed; Oceanographic instruments, Mining of manganese nodules, Deep sea drilling methods, Ocean bottom samplers, Drag buckets, Grab buckets; Coring systems; Ocean bathymetry; Temperature measurement systems; Water samplers; Ocean dynamic analysis; Beach placer mining; Underwater photographs; Vehicles and transportation; offshore oil platforms.

TEXT BOOKS

1. Ghose, A. K., (Ed). Small Scale Mining – A Global Overview, Oxford - IBH Publishers,1991.
2. Shepherd, F.P., Sub-marine Geology, Harper and Row, New York,1963.
3. Howard L. Hartman, Jan M Mutmansky, Introductory Mining Engineering, Wiley, 2002.

REFERENCES BOOKS

1. Chatterjee, S.K. An Introduction to Mineral Resources, Wiley Eastern Ltd.,1983.
2. Graff, W.J., Introduction to Offshore Structures: Design, Fabrication and Installation, Gulf Publishing Company, London,1961.
3. Herbich, J.B., Coastal and Deep Ocean Dredging, Gulf Publishing Co. Houston,1975.
4. Murthy, T.K.S., Mining the Ocean, CSIR Golden Jubilee Series, CSIR Publications, New Delhi,1995.

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ELECTIVE IV

MN.8.4.1 - ENTREPRENEURSHIP DEVELOPMENT

Course objective: Entrepreneurship is an effective way to promote self-employment as well as to create job opportunities for others, leading to industrial development of the country.

Instructional Objective: The course emphasises on learning by doing with a bitof theoretical concept to equip the students with understanding the life cycle of a business venture and developing entrepreneurial skills in them.

TeachingScheme:
Lecture:3Hrs/week
Practical:3Hrs/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Entrepreneur- Evolution, Characteristics, Types, Functions of Entrepreneur;
Entrepreneurship - Concept, Need, Problems, Stages, Growth in India, Role in Economic Development and its Barriers.
Recent Trends, Motivation, Theories, factors, Entrepreneurial Competencies, Small Enterprises - Definition, Characteristics, Relationship between Small and Large Units, Rationale, Objectives, Scope, Opportunities for an Entrepreneurial Career, Role of small Enterprise in Economic development, Problems of SSIs.

Module 2

Small-Scale Industry - Definition, Characteristics, Need and rationale, Objectives; scope; role of SSI in Economic Development. Advantages of SSI, Steps to start an SSI-government policy towards SSI; Different policies of SSI; government support for SSI. Impact of Liberalization, Privatization, Globalization on SSI, Effect of WTO/GATT supporting agencies of Government for SSI, meaning; Nature of support; Objectives;Functions.

Module 3

Project Identification and Selection (PIS): Business ideas, Market Survey, Meaning of project, Project identification, Project selection, Project formulation: Meaning, Significance, Contents, Formulation, Planning Commission's guidelines for formulating a Project Report, Specimen of a Project Report, Network analysis, Common errors in Project formulation, Project appraisal concept, Methods of project appraisal, IntellectualProperty.

Module 4

Financing Of Enterprises- Need for Financial Planning, Sources of finance, Capital Structure, Term-loan, Sources of Short-Term Finance, Capitalization, Venture capital, Export Finance, Institutional Finance To Entrepreneurs, Preparation of Business Plans, Commercial Banks, Other financial institutions. Institution support to entrepreneurs: Need for Institutional support - Small Entrepreneurs: NSIC, SIDO, SSIB, SSICS, SISI, DICs, Industrial Estates Specialized Institutions, TCOs Brief introduction about Marketing of products and services, Human resource issues, Total quality management issues for small enterprises, Growth strategies in small businesses, sickness in small businesses, small enterprises in international business.

PRACTICALS/ACTIVITIES (Suggestive):

1. Visit to 3 or 4 small scale industries in industrial estate and preparation ofreport.
2. Identify some successful and unsuccessful ventures from a variety of sectors through internet, journals, business magazines, etc. and enumerate the reasons for theirsuccess andfailure.
3. Ideate a few business plans through observation, discussion and literature survey (internet, newspaper, journal, business magazines and Govt. bulletins) and select the best one using Discounted Cash Flow and othermethods.
4. Working on Business ModelCanvas.
5. Identify raw materials/other input resources required for the selected businessplan, and their source of procurement through internet, business magazines,etc.
6. Approach banks/financial institutes and discuss concerned officials to find the terms and conditions for availing business loans and, also prepare a comparative report to source of funds to start a businessenterprise.
7. Estimate the cost of production and calculate Break Even Point for selectedbusiness plan.
8. Determine average cost of funds if raised from varioussources.
9. Estimate working capital required for the selected businessplan.
10. Identify approvals and sanctions required from Govt. and otheragencies.
11. Enumerate the activities which are critical for the completion of the projectand estimate its completion time using CPM and PERTtechniques.
12. Prepare Feasibility Report for a given businessplan.

It is mandatory to perform eight practicals/activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. Entrepreneurship Development- Small Business Enterprises- Poornima M Charantimath, Pearson Education,2006.
2. Dynamics of Entrepreneurial Development & Management- Vasant Desai, Himalaya Publishing House,2007.

3. Bragg A. & Bragg M (2005) Developing New Business Ideas, a step-by-step guide to creating new business ideas worth backing, Financial Times, PrenticeHall.

REFERENCE BOOKS

1. P. C. Tripathi, P. N. Reddy, "Principles of Management" Tata McGraw Hill,2007.
2. Robert Lusier," Management Fundamentals - Concepts, Application, Skill evelopment" Thomson2007.
   S S Khanka, "Entrepreneurship Development" S Chand & Co, 2007.
3. Rao and Pareek, Handbook ofEntrepreneurship
4. Forbat, John, "Entrepreneurship" New AgeInternational.
5. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New AgeInternational
6. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep 8 Deep Publications (P),Ltd.
7. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai,2002.

WEB REFERENCES:

1. *srdc.msstate.edu/set/files/entrepreneurship_power_point_savedown.ppt*
2. www.wiley.com/canada/schermerhorn/ppt/ch06.ppt
3. *http://agropedialabs.iitk.ac.in/agrilore/sites/default/files/Entrepreneurship%20development_1.ppt*

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ELECTIVE IV

MN.8.4.2 - EXPLORATION GEOLOGY

Course Objective: Geological exploration data is the fundamental input for mine planning and design. Mineral inventory continuously changes with progress in the exploratory works.

Instructional Objective: Students will have practical exposure to the complex activities involved in mineral exploration.

TeachingScheme:
Lecture: 3 Hr/week
Practical:3Hrs/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours

Syllabus Content

Module 1

Scope of Exploration Geology, Introduction to important mineral resources in India and world. Main features of Mineral Concession Rules and MineralConservation & Development Rules.

Different methods of prospecting, reconnaissance Survey. Various exploration and sampling techniques: Techniques of geological mapping, field data collection: attitude of beds, foliation, lineation, joints, and theiranalysis.

Stereographic Projections: Principle, Definition, Procedure and application in Mining Geology

Groundwater: Occurrence, Origin, importance in mining. Concept of Flow Nets

Module 2

Remote Sensing: Fundamentals, Applications in geology, ground water and natural resource management. Aerial Photography.

Exploratory Drilling: Diamond drilling, Collection and stacking ofcore.Bore Hole Logging: Introduction logging methods, preparation of lithologs, log interpretation.

Underground Exploration: Exploratory mining by shafts, drifts and cross-cuts, Definition drilling.

Module 3

GeophysicalExploration: electrical method: Principles, instrumentation, field procedure and interpretation using electrical methods. Electrical profiling and sounding usingWenner

and Schlumberger configurations. Principles and fundamental procedures of data collection and interpretation

Seismic Methods: Principles, instrumentation, survey procedures and interpretation using seismic methods. Correction applied to seismic data.

Gravity and magnetic methods: Principles-field methods-gravimeters-corrections, interpretation of gravity data. Corrections and applications.Principles, instrumentation, field procedures and interpretation of magnetic data.

Module 4

Geochemical Exploration: Principles & Methods; Interpretation of Geochemical Data **Estimation of Reserves**: Classification, methods, interpretation. Ore reserve classification as per UNFC.

Geological Maps: Map reading, interpretation of geological sections.

Production Planning: Usage of mine sections and Sampling data in production planning.

PRACTICALS/ACTIVITIES (Suggestive):

1) Geological Mapping with compass andtape.
2) Tabulation of the bore holedata using bore-holelogs.
3) Given a toposheet and the Bore Hole data of an area, draw sections atdifferent intervals.
4) Bore Hole Problems to ascertain Dip, Strike andFault.
5) Reserve Estimation Problems (DifferentMethods).
6) Calculation of stripping ratio from sections and givendata.
7) Production Planning based on mine section and Samplingdata
8) Interpretation of Geophysical Resistivity and Seismic Refraction surveydata.
9) Interpretation of AerialPhotographs.
10) Completion of Outcrops from the available data (number of outcrops, dip & strike given).
11) Stereographic projections based on the strike & dipdata.
12) Basics of Groundwater Flow Nets (drawing of flow nets and theirinterpretation).

It is mandatory to perform eight practicals/activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS

1. Hartman H. L., Jan M. Mutmansky, Introductory Mining Engineering. John Wiley & Sons,2002.
2. Roger Marjoribanks, 2010. Geological Methods in Mineral Exploration and Mining. Springer
3. R. N. P. Arogyaswami, 1996. Courses in Mining Geology. Oxford & IBHPubl.

REFERENCE BOOKS

1. T. S. Ramakrishna, 2006. Geophysical Practice in Mineral Exploration andMapping. GSIPubl.
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5. Peters W.C, Exploration and Mining Geology Wiley, New York,1978
6. S.Bhattacharjee, Frontiers in Exploration Geophysics, Oxford & IBH PublishingCo. 1992

WEB REFERENCES:

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2. https://www.d.umn.edu/~pmorton/geol5350/2009/econclassnotes2009.pdf
3. http://www.al.gov.bc.ca/clad/strategic_land/blocks/cabinet/mineral_exploration.pdf
4. http://www.portal.gsi.gov.in/gsiDoc/pub/DID_IronPart1.pdf

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ELECTIVE IV

MN.8.4.3 - COMPUTER APPLICATION IN MINING

Course Objective: Computer application in different areas of mining is necessary for enhancing production, productivity and safety. It requires the knowledge of software for a variety of mining applications.

Instructional Objective: To impart knowledge on hardware and software issues concerned with computer application in mining industry, development of algorithms and programs on various mining related problems.

TeachingScheme:
Lecture: 3 Hrs/week
Practical:3Hrs/week

ExaminationScheme:
Theory (3 Hours): 100Marks
Sessional: 25Marks
Oral: 50 Marks

The syllabus consists of four modules of equal weightage. Two questions shall be drawn from each module for term end theory examination. Total five questions to be answered taking minimum one question from each module. Duration of examination is three hours.

Syllabus Content

Module 1

Introduction to Computers: Importance of computer application in mining, Different areas of application. Introduction to Computers and hardware for application in mining industry. Computer graphics, model simulation and virtual reality, artificial intelligence, expert system, neural networks, simulated annealing, robotics.

Module 2

Software: Application of structured and object oriented programming languages to mining problems like pillar design, blast design, subsidence etc. Introduction to mining application software like CAE STUDIO 3, SURPAC, BLASTWARE, FRAGLYST, GALENA, ANSYS, FLAC, UDEC, STABL, VENTSIM.

Module 3

Database Management Systems: Database and Relational database - development of software packages for mining companies – forms, queries and reports: Management Information System – enterprise resource planning for safety, production machineries, manpower, finance, and other mining operations.

Module 4

Problem Solving–Applications in Mining: Ventilation network analysis; online and offline monitoring and control. CAD in mining – geo-statistics, reserve estimation, kriging, block modelling and orebody modelling, pit design and optimization, mine scheduling, Truck dispatch system, blast design etc., digitization and scanning of mine maps - GIS in mining.

PRACTICALS/ACTIVITIES (Suggestive):

To develop algorithms and programs on various mining related problems in any programming languages/using software packages.

1. Data generation, collection and Validation through computers forexploration.
2. Digital Terrain modelling, String and Wire-framemodelling.
3. Ore body modelling and reserveestimation.
4. Open pit Mine planning anddesign:
    a. Generation of external dumps, mine pit, haulage roads and ultimate pitdesign.
    b. ExcavationScheduling.
5. Slope stabilityanalysis.
6. Truck dispatch systemoptimization.
7. Underground Mine planning anddesign:
    a. Generation of mine entry, minedevelopment.
    b. ExcavationScheduling
8. Development of algorithm/Modelling of airflow through undergroundworkings.
9. Digitisation and scanning of mineplans.
10. Production scheduling for gradecontrol.
11. Management Information System and Database management systemsfor:
    a. Productionreporting.
    b. Statutory report and returns.
    c. SafetyManagement.
12. Computer programming for mining problems like design of pillars / blastdesign /Subsidence prediction.

It is mandatory to perform eight practicals/activities based on the above list. Performing more than eight is, however, encouraged.

TEXT BOOKS:

1. Ramani R.V., et al. Computers in Mineral Industry, Oxford and IBH Publishers,1994.
2. Fytas, K. and Singhal, R.K. Computers Applications in Mineral Industry, A.A. Balkema Publication,1988.

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1. R.V. Ramani – Editor, APCOM Proceedings Application of Computers and operations Research in the Mineral Industry, The Society of Mining, Metallurgy and Exploration,Inc.,1996
2. KadriDagdelen, Editor, Computer Applications in the Minerals Industries, Colorado School of Mines,1999.
3. E Balagurusamy, Fundamentals of Computers , Mc Graw Hills Publication,2009
4. S. K. Basandra Computers Today Fourth Ed., Galgotia Publications Pvt. Ltd,2004

WEB REFERENCE:

1.http://www.maden.org.tr/resimler/ekler/abdfbd11b37a9f8_ek.pdf.

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MN.8.5 - PROJECT (Final)

Course objective: Application of the knowledge gained during the course of study in solving problems through new approaches is necessary to be successful in one's career.

Instructional Objective: To encourage the students to work in a group so that they will develop team and leadership qualities leading to solution of specific problems in mines.

TeachingScheme:
Practical: 8Hrs/week

ExaminationScheme:
Sessional: 50Marks
Oral: 100 Marks

GUIDELINES FOR PROJECT:

This project is in continuation of Project (Interim). After deciding the topic, identifying the problem and formulating the objectives of the study, the students need to plan the methodology to be adopted during previous semester. One or more approaches i,e. field oriented, laboratory-based, a combination of both, development of models and programmes should be decided by the students to achieve the desired objectives. The method one plans to use must be suitable and feasible.

1. Planning about the requirements for equipment, materials, field trips and approximate time for completion of eachstage.
2. Carrying out field investigations and experiments to generatedata.
3. Compilation and analyses of data obtained using appropriate analysistechniques.
4. Drawing conclusions and suggesting the areas for furtherwork.
5. ReportPreparation

Project Report

The findings and results should be completely and accurately described in the report. In the light of the results obtained and literature review, a thorough discussion should be included in the project report. The report shall be properly structured and divided into different chapters. In general, the project Report shall consists of

1) Certificate	**5)** Literaturereview
2) Abstract	**6)** Methodology
3) Preliminaries	**7)** Results
i. Acknowledgement	**8)** Analysis andDiscussion
ii. Table ofcontents	**9)** Conclusions andRecommendations for furtherstudies
iii. List offigures	
iv. List ofTables	**10)** References
4) Introduction	**11)** Appendix

Evaluation:

The progress of the work will be evaluated by the guide during the last week of every month. Mid Semester evaluation will be done by the departmental committee. Students shall submit project reports to the department and make a presentation before the committee.