NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

COURSE STRUCTURE & SYLLABUS

FOR

BACHELOR OF TECHNOLOGY

IN

MINING ENGINEERING
(B.TECH-MN)

Netaji Subhas University Pokhari, Near Bhilai Pahadi

Jamshedpur, Jharkhand

MINING ENGINEERING DEPARTMENT

VISION

To impart quality education in Mining Engineering and constantly pursuing excellence by upgrading knowledge skills and attitude useful to Industry, Academic and Society.

MISSION

1. To produce graduates having professional excellence in Basic Sciences and Mining Engineering with concern towards society
2. To provide a scientific environment, to help meet the desires and needs of students and faculty for enhancing research efforts and technological innovations.
3. To provide technical support to higher education, industry and R&D units.

Program Educational Objectives (Mining Engineering)

The Mining Engineering program at NSU prepares graduates who can

PEO 1

Obtain good and high positions in public or private institutions as engineers and researchers.

PEO 2

Follow higher education in prestigious universities and have a successful academic career.

PEO 3

Demonstrate advancement in their chosen career by upgrading their skills continuously.

PEO 4

Exhibit high ethical standards and responsibilities towards their profession and society.

Program Outcomes (Mining Engineering)

PO 1	**Engineering Knowledge:** Knowledge of mathematics, science, and engineering fundamentals and ability to apply them to solve complex metallurgical phenomena.
PO 2	**Problem Analysis:** Identification and analysis of process - structure – property – performance correlation of metals and materials with the knowledge of science and engineering principles.
PO 3	**Design/Development of solutions:** Ability to design material systems, components, process to meet the desired needs within the realistic constraints of economic, public safety, environmental, manufacturability, and sustainability.

PO 4	**Conduct Investigations of Complex problems:** Design, conduct, analyze, and interpret the results of tests and researches in the field of metallurgical engineering and propose appropriate measures for efficient capacity utilization of systems; components and equipment etc. with minimum energy and rejects.
PO 5	**Modern Tool Usage:** Select and apply appropriate methods for analysis and characterization of materials to check the quality and performance and usage of modern tools to address the specific needs of metallurgical industries.
PO 6	**The Engineer and Society:** Propose appropriate measures for protection and modifying equipment, systems and processes from damage, degradation and inefficiency due to various physical, chemical and mechanical environments.
PO 7	**Environment and Sustainability:** Understanding the impact of various metallurgical processes on environment and suggest appropriate measures for viable alternatives and taking measures for reuse, recycle and reclamation of rejects and byproducts.
PO 8	**Ethics:** An understanding of professional and ethical responsibility towards engineering practice and profession.
PO 9	**Individual and Team Work:** Ability to function in diverse teams and works.
PO 10	**Communication:** Ability to effectively communicate in professional context through oral presentations and written technical reports as well as successfully work in group oriented tasks.
PO 11	**Project Management and Finance:** Demonstrate the fundamental knowledge and skills associated with technical and management principles and application of them at individual and as member or a leader of a team and in multidisciplinary environment at various platforms.
PO 12	**Life-Long Learning:** Recognition of the need; ability and awareness to engage independently and exhibit creativity; innovations and proactive demeanor for engaging in lifelong learning.

Program Specific Outcomes (Mining Engineering)

PSO 1

Apply Mining principles to provide ecological and cost effective solutions for metal extraction and refining industries and manufacturing industries.

PSO 2

Identify, evaluate and modify existing materials and their behaviour with respect to structure – property – processing – performance applications and develop new materials that are sustainable, economical and eco-friendly with tailor made properties and applications.

PSO 3

Understand, evaluate, modify and design existing manufacturing processes, characterization techniques and develop new processes to specific engineering applications and ensure reliable and sustainable products.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

B.Tech. in MINING ENGINEERING

I YEAR Ist SEMESTER

S. No.	Course Code	Course Title	Periods			Credits	Marks		
			L	T	P		IA	TE	TM
1	BT 101	Engineering Mathematics-I	3	1	-	4	30	70	100
2	BT 102	Engineering Physics	4	-	-	4	30	70	100
3	BT 103	Programming in C	4	-	-	4	30	70	100
4	BT 104	Elements of Mechanical Engineering	3	-	-	4	30	70	100
5	BT 105	Basic of Electrical Engineering	3	-	-	4	30	70	100
6	BT 106	Professional Communication Skill	3	-	-	3			
7	BT 107 L	Engineering Physics Lab	-	-	4	2	15	35	50
8	BT 108 L	Programming in C Lab	-	-	4	2	15	35	50
		Total Credits	**20**	**1**	**8**	**27**	**210**	**490**	**700**

I YEAR IInd SEMESTER

S. No.	Course Code	Course Title	Periods			Credits	Marks		
			L	T	P		IA	TE	TM
1	BT 201	Engineering Mathematics-II	3	1	-	4	30	70	100
2	BT 202	Engineering Chemistry	4	-	-	4	30	70	100
3	BT 203	Elements of Civil Engineering and Mechanics	4	-	-	4	30	70	100
4	BT 204	Computer Aided Engineering Drawing	4	-		4	30	70	100
5	BT 205	Basic Electronics	4	-	-	3	30	70	100
6	BT 206	Software Engineering	3	1		3			
7	BT 207 L	Engineering Chemistry Lab	-	-	4	2	15	35	50
8	BT 208 L	Workshop Practice	-	-	4	2	15	35	50
		Total Credits	**22**	**1**	**8**	**26**	**210**	**490**	**700**

II YEAR III SEMESTER

S. No.	Course Code	Course Title	Periods			Credits	Marks		
			L	T	P		IA	TE	TM
1	BT MN301	Probability and Statistics & Complex Variables	3	1	-	4	30	70	100
2	BT MN302	Fluid Mechanics and Hydraulic Machines	3	1	-	4	30	70	100
3	BT MN303	Mechanics of solids	3	-	-	3	30	70	100
4	BT MN304	Mine Surveying	3	1	-	4	30	70	100
5	BT MN305	Development of Mineral Deposits	3	-	-	3	30	70	100
6	BT MN306	Constitution of India	3	-	-	3	30	70	100
7	BT MN307L	Mine Surveying – I Lab	-	-	4	2	15	35	50
8	BT MN308L	Fluid Mechanics and Hydraulic Machines Lab	-	-	4	2	15	35	50
		Total Credits	**18**	**3**	**8**	**27**	**210**	**490**	**700**

II YEAR IV SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits	Marks		
							IA	TE	TM
1	BT MN 401	Mining Geology	3	0	0	3	30	70	100
2	BT MN 402	Mine Planning and Design		0	0	3	30	70	100
3	BT MN 403	Mine Mechanization - I	3	1	0	4	30	70	100
4	BT MN 404	Drilling and Blasting	3	1	0	4	30	70	100
5	BT MN 405	Mine Environmental Engineering - I	3	0	0	3	30	70	100
6	BTMN406	Rock Fragmentation Engineering	3	1	0	4	30	70	100
7	BT MN 407 L	Mining Geology lab	0	0	4	2	15	35	50
8	BT MN 408 L	Mine Surveying – II Lab	0	0	4	2	15	35	50
		Total Credits	15	2	8	25	210	490	700

III YEAR V SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits	Marks		
							IA	TE	TM
1	BT MN501	Introduction to Industrial Engineering	3	-	-	3	30	70	100
2	BT MN502	Environmental Management in Mines	3	-	-	3	30	70	100
3	BT MN503	Mine Environmental Engineering -II	3	1	-	4	30	70	100
4	BT MN504	Mine Mechanization-II	3	1	-	4	30	70	100
5	BT MN505	Surface Mining Technology	3	1	-	4	30	70	100
6	BT MN506	Intellectual Property Rights	3	-	-	3	30	70	100
7	BT MN507 L	Mineral Processing Engineering Lab	-	-	4	2	15	35	50
8	BT MN508 L	Mine Mechanization Lab	-	-	4	2	15	35	50
		Total Credits	**18**	**3**	**12**	**27**	**210**	**490**	**700**

III YEAR VI SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	MARKS		
							IA	TE	TM
1	BT MN601	Tunneling Engineering	3	-	-	3	30	70	100
2	BT MN602	Mineral Processing	3	-	-	3	30	70	100
3	BT MN603	Introduction to Instrumentation	3	1	-	4	30	70	100
4	BT MN604	Underground Coal Mining Technology	3	1	-	4	30	70	100
5	BT MN605	Rock Mechanics Engineering	3	1	-	4	30	70	100
6	BT MN606	Environmental Science	3	-	-	3	30	70	100
7	BT MN607L	Ground Control & Instrumentation Lab and Computer Applications in Mining Lab	-	-	4	2	15	35	50
8	BT MN608L	Rock Mechanics Engineering Lab	-	-	4	2	15	35	50
		Total Credits	**18**	**3**	**8**	**27**	**210**	**490**	**700**

IV YEAR VII SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits	Marks		
							IA	TE	TM
1	BT MN 701	Advanced Surface Mining	3	0	0	3	30	70	100
2	BT MN 702	Risk Assessment And Management	3	0	0	3	30	70	100
3	BT MN 703	Mine Systems Engineering	3	0	0	3	30	70	100
4	BT MN 704	Underground Metal Mining Technology	4	0	0	4	30	70	100
5	BT MN 705	Mine Legislation	3	0	0	3	30	70	100
6	BT MN 706	Industrial Visits /Trainings	0	0	0	2	-	100	100
7	BT MN 707	Project Stage - I	0	0	6	6	50	50	100
		Total Credits	**16**	**0**	6	**24**	**200**	**500**	**700**

IV YEAR VIII SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits	marks		
							IA	TE	TM
1	BT MN801	Mine Economics	3	0	0	4	30	70	100
2	BT MN802	Mineral Exploration	3	0	0	4	30	70	100
3	BT MN803	Mine Subsidence Engineering	3	0	0	4	30	70	100
4	BT MN804	Seminar	1	0	0	2	100	-	100
5	BT MN805	Comprehensive viva voce	-	-	3	2	-	100	100
6	BT MN806	Project work	0	0	12	**6**	50	50	100
		Total credits	**10**	**0**	**15**	**22**	**240**	**360**	**600**

ENGINEERING MATHEMATICS-I (BT 101)

Course Objectives:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following:

- n^{th} derivatives of product of two functions and polar curves.
- Partial derivatives
- Vector calculus
- Reduction formulae of integration; to solve First order differential equations.
- Solution of system of linear equations, quadratic forms.

Course outcomes:

On completion of this course, students are able to

- **CO-1:** Use partial derivatives to calculate rates of change of multivariate functions.
- **CO-2:** Analyze position, velocity, and acceleration in two or three dimensionsusing the calculus of vector valued functions.
- **CO-3:** Recognize and solve first-order ordinary differential equations, Newton's lawof cooling
- **CO-4:** Use matrices techniques for solving systems of linear equations in thedifferent areas of Linear Algebra.

UNIT-I

Differential Calculus -1: Determination of n^{th} order derivatives, Leibnitz's theorem (without proof)- problems.

Taylor's and Maclaurin's theorems for function of one variable (statement only)- problems. Evaluation of Indeterminate forms.

Partial derivatives – Definition and simple problems, Euler's theorem (without proof) – problems, total derivatives, partial differentiation of composite functions- problems. Definition and evaluation of Jacobians.

UNIT-II

Differential Calculus -2

Polar Curves - Angle between the radius vector and tangent, angle between two curves, Pedal equation of polar curves. Derivative of arc length - Cartesian, Parametric and Polar forms (without proof)- problems. Curvature and Radius of Curvature – Cartesian, Parametric, Polar and Pedal forms (without proof) - problem.

UNIT-III

Integral Calculus:

Reduction formulae - $\int Sin^n x\ dx$, $\int Cos^n x\ d$, $\int Sin^m x\ Cos^n x\ dx$, (m and n are positive integers), evaluation of these integrals with standard limits (0 to $\pi/2$) and problems.

UNIT-IV

First order Differential Equations:

Exact, reducible to exact and Bernoulli's differential equations. Orthogonal trajectories in Cartesian and polar form. Simple problems on Newton's law of cooling.

UNIT-V

Linear Algebra

Rank of a matrix by elementary transformations, solution of system of linear equations - Gauss-elimination method, Gauss–Jordan method and Gauss-Seidel method, Linear transformation, Eigen values and Eigen vectors. diagonalisation of a square matrix. Reduction of Quadratic form.

Text Books:

1. B.S. Grewal, **"Higher Engineering Mathematics"**, Khanna publishers, 42nd edition, 2013.

2. Erwin Kreyszig, **"Advanced Engineering Mathematics**, Wiley, 2013

Reference Books:

1. B.V. Ramana, **"Higher Engineering Mathematics"**, Tata Mc Graw-Hill, 2006
2. N.P. Bali and Manish Goyal, **"A text book of Engineering mathematics"**, Laxmi publications, latest edition.
3. H.K. Dass and Er. Rajnish Verma, **"Higher Engineering Mathematics"**, S.Chand publishing, 1st edition, 2011.

Course Outcomes (COs):

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Use partial derivatives to calculate rates of change of multivariate functions.	K1
CO2	Analyze position, velocity, and acceleration in two or three dimensions using the calculus of vector valued functions.	K3
CO3	Recognize and solve first-order ordinary differential equations, Newton's law of cooling	K6
CO4	Use matrices techniques for solving systems of linear equations in the different areas of Linear Algebra.	K2

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

CO–PO Mapping Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO Average	2.66		2	3	1		1	2	1.66			

ENGINEERING PHYSICS (BT102)

Course Objectives:

The Objective of this course is to make students learn and understand basic concepts and principles of physics to analyze practical engineering problems and apply its solutions effectively and meaningfully. To understand building up of models, design issues, practical oriented skills and problem solving challenges are the great task of the course. To know about shock waves and practical applications is the prime motto to introduce new technology at the initial stage of Engineering.

Course outcomes:

On Completion of this course, students are able to –

CO-1: Learn and understand more about basic principles and to develop problem solving skills and implementation in technology.

CO-2: Gain Knowledge about Modern physics and quantum mechanics will Update the basic concepts to implement the skills.

CO-3: Study of material properties and their applications is the prime role to understand and use in engineering applications and studies.

CO-4: Study Lasers and Optical fibers and its applications are to import knowledge and to develop skills and to use modern instruments in the engineering applications.

CO-5: Understand Crystal structure and applications are to boost the technical skills and its applications.

CO-6: Expose shock waves concept and its applications will bring latest technology to the students at the first year level to develop research orientation programs at higher semester level.

CO-7: Understand basic concepts of nano science and technology.

UNIT-I:

Quantum Mechanics

Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional box.

UNIT-II:

Semiconductor Physics

Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Carrier transport: diffusion and drift, Hall effect, p-n junction diode, Zener diode and their V-I Characteristics, Bipolar Junction Transistor (BJT): Construction, Principle of operation.

UNIT-III:

Optoelectronics

Radiative and non-radiative recombination mechanisms in semiconductors, LED and semiconductor lasers: Device structure, Materials, Characteristics and figures of merit, Semiconductor photodetectors: Solar cell, PIN and Avalanche and their structure, Materials, working principle and Characteristics.

UNIT-IV:

Lasers and Fiber Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

UNIT-V:

Electromagnetism and Magnetic Properties of Materials

Laws of electrostatics, Electric current and the continuity equation, Ampere's and Faraday's laws, Maxwell's equations, Polarisation, Permittivity and Dielectric constant, Internal fields in a solid, Clausius-Mossotti equation, Ferroelectrics and Piezoelectrics. Magnetisation, permeability and

susceptibility, Classification of magnetic materials, Ferromagnetism and ferromagnetic domains, Hysteresis, Applications of magnetic materials.

Text Books:

1. Wiley precise Text, **Engineering Physics,** Wiley India Private Ltd., New Delhi. Book series – 2014,
2. Dr. M.N. Avadhanulu, Dr. P.G.Kshirsagar, Text Book of Engineering Physics**,** S Chand Publishing, New Delhi – 2012

Course Outcomes (COs):

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Use partial derivatives to calculate rates of change of multivariate functions.	K1
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CO–PO Mapping Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO Average	2.66		2	3	1		1	2	1.66			

PROGRAMMING IN C (BT103)

Course Objectives:

- Design solutions to simple engineering problem by applying the basic programming principles of C language and basic mathematical knowledge.
- Choose a suitable C-construct to develop C code for a given problem.
- Recognize the bugs in the C program.
- Apply the C-language syntax rules to correct the bugs in the C program.
- Develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.

Course outcomes:

After the completion of this course, students will be able to:

- **CO1:** Illustrate and explain the basic computer concepts and programming principles of C language.
- **CO2:** Develop C programs to solve simple mathematical and decision making problems.
- **CO3:** Develop C programs to solve simple engineering problems using looping constructs.
- **CO4:** Develop C programs to demonstrate the applications of derived data types such as arrays, pointers, strings and functions.

UNIT-I

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices. Application Software & System software: Compilers, interpreters, High level and low level languages, Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudo code*)

UNIT -II

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence, Preprocessor directive

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. (Simple programs covering control flow)

UNIT-III

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array String processing:

In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets). Linear search program, bubble sort program, simple programs covering arrays and strings

UNIT-IV

Pointers

Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer, array accessusing pointers, pass by reference effect

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

UNIT-V

Structure & Union

Introduction, Declaration and Initialization, Array of Structures, Unions.

File Handling

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handling functions (*rewind() ,fseek(), ftell(),feof(), fread(), fwrite()*), *simple programs covering pointers and files.*

Text Books

1. Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C
2. E. Balagurusamy, Mcgraw Hill,Programming in ANSI C
3. Asok N Kamthane, Pearson,Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Course Outcomes (COs):

Course Outcome No	Statement	Knowledge Level (K)
CO1	Use partial derivatives to calculate rates of change of multivariatefunctions.	K1
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CO–PO Mapping Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO Average	2.66		2	3	1		1	2	1.66			

ELEMENTS OF MECHANICAL ENGINEERING (BT104)

Course objectives:

- Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and process.

Course outcomes:

Students shall demonstrate knowledge associated with,

- **CO-1:** Various Energy sources, Boilers, Prime movers such as turbines and IC engines,refrigeration and air-conditioning systems
- **CO-2:** Metal removal process using Lathe, drilling, Milling Robotics and Automation.
- **CO-3:** Fair understanding of application and usage of various engineering materials.

UNIT-I

Energy Resources: Non-renewable and renewable energy resources, Petroleum based solid, liquid and gaseous fuels, Calorific values of fuels, Combustion and combustion products of fuels.

Solar Power: Solar Radiation, Solar constant (definition only), Solar Thermal energy harvesting, ex: liquid flat plate collectors, solar ponds (principle of operation only),Solar photovoltaic principle.

Wind Power: principle of operation of a typical windmill.

Hydro Power: Principles of electric power generation from hydro power plants,

Nuclear Power: Principles of Nuclear power plants,

Bio Fuels: introduction to bio fuels, examples of various biofuels used in engineering applications, Comparison of biofuels withpetroleum fuels in terms of calorific value and emission.

UNIT-II

Turbines and IC Engines and Pumps Steam turbines: Classification, Principle of operation of Impulse and reaction turbines, Gas turbines: Classification, Working principles and Operations of Open cycle and closed cycle gas turbines.

Water turbines: Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine

Internal Combustion Engines: Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, andspecific fuel consumption.

UNIT-III

Machine Tools Operations: Turning, facing, knurling, Thread cutting, Taper Turning , Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring, - Plane milling, End milling, Slot milling. (No sketches of Machine tools, sketches to be used only for explaining operations.)

UNIT-IV

Engineering materials and joining processes: Engineering Materials: Types and applications of Ferrous & Nonferrous metals and alloys,

Composites: Definition, Classification and applications(Air craft and Automobiles)

Soldering, Brazing and Welding:

Definitions, classification and method of soldering, Brazing and welding. Differences between soldering, Brazing and Welding. Description of Electric Arc Welding and Oxy-Acetylene Welding.

UNIT-V

Refrigeration, Air-Conditioning:

Refrigerants: properties of refrigerants, list of commonly used refrigerants. Refrigeration –Definitions – Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, unit of Refrigeration. Principle and working of vapor compression refrigeration and vapour absorption refrigeration: Principles and applications of air conditioners, Room air conditioner.

Text Books:

1. V.K.Manglik, "Elements of Mechanical Engineering", PHI Publications, 2013.(Module-1,2,4,5)
2. Mikell P.Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI(Module -3)
3. K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering"- Subhash Publishers, Bangalore. (Module -1,2,3,4,5) BASIC OF ELECTRICAL ENGINEERING (BT105)

Basic of Electrical Engineering (BT105)

Course objectives:

- Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
- Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
- Develop selection skill to identify the type of generators or motors required for particular application.
- Highlight the importance of transformers in transmission and distribution of electric power.
- Emphasize the effects of electric shock and precautionary measures.
- Improve the ability to function on multi-disciplinary teams.

UNIT -I

Ohm's law and Kirchhoff's laws, analysis of series, parallel circuit by independent voltage sources, concept of power and energy, definition of magnetic circuit and analogy between electric and magnetic circuits, faradays laws of electromagnetic induction, concept of Network Theorem.

UNIT-II

Single Phase A.C. Circuits: Average value, R.M.S. value, form factor and peak factor for sinusoidal wave form, Steady State Analysis of series R-L-C circuits. Concept of Reactance, Impedance, Susceptance, Admittance, Concept of Power Factor, Real, Reactive and Complex power, Illustrative Problems.

UNIT-III

Single phase transformers: principle of operation, constructional features and emf equation. DC. Generator: principle of operation, constructional features, emf equation.

DC Motor: principle of operation, Back emf, torque equation.

UNIT-IV

Three phase Induction Motor: principle of operation, types; Synchronous Machines: principle of operation of Synchronous generator and motor. EMF equation, Voltage regulation, Applications and starting of Synchronous motor. Introduction to single-phase induction Motor.

UNIT-V

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption and battery backup.

Measuring Instruments: Construction and Principle of operation of dynamometer type wattmeter and single-phase induction type energy meter.

Course outcomes:

CO-1: To predict the behaviour of electrical and magnetic circuits.

CO-2: Select the type of generator / motor required for a particular application.

CO-3: Realize the requirement of transformers in transmission and distribution of electricpower and other applications.

CO-4: Practice Electrical Safety Rules & standards.

CO-5: To function on multi-disciplinary teams.

Course Outcomes (COs):

CO1	To predict the behavior of electrical and magnetic circuits.	K1
CO2	Select the type of generator / motor required for a particular application.	K2
CO3	Realize the requirement of transformers in transmission and distribution of electricpower and other applications.	K4
CO4	Practice Electrical Safety Rules & standards.	K3
CO5	To function on multi-disciplinary teams.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

TEXTBOOK

1. D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition 2011

PROFESSIONAL COMMUNICATION SKILL (BT106)

Course Objective:

To enable students how to improve communication skills.

- To develop Writing skills in preparing business letters, report, memos, and proposals. To develop Oratory skills through public speaking
- To understand importance of professional attire in corporate environment.
- To get knowledge on various business etiquette and inculcate the etiquette for corporate fit.

UNIT-I : Concepts of Communications

Introduction: Definition and Process of Communication - Forms of Verbal and Non-verbal Communication.

Barriers of Communication: Communication Barriers and Overcoming Communication Barriers - Guidelines for Effective Communication.

Business Writing: Direct and Indirect approaches to Business Writing - Five Main Stages of Writing Business Messages.

Exercise: Role Play, Square Talk Activity.

UNIT-II: Written Business Communication

External Communication: The Seven C's of Letter writing - Kinds of Business Letters - Business Reports and Proposals - Purpose of Business Reports.

Internal Communication: Format and Principles of Writing Memos - General Warning - Cautions. Exercise: Preparation of Reports on different issues.

UNIT-III: Oral Communication

Public Speaking: Types of Public Speaking - importance of Public Speaking.

Power Point Presentation: Planning the Presentation - Delivering the Presentation - Developing & Displaying Visual Aids - Handling Questions from the Audience.

Listening: Definition - Types of Listening Skills - Features of a Good Listener - Causes and effects of Poor Listening.

Exercise: Elocution and Extempore

UNIT-IV: Behavioral Techniques

Body Language: Facial Expressions - Body Posture - Gestures - Eye Movement - Touch and the use of Personal Space.

Business Attire and Grooming: Different types of Attire - Guidelines for Business Attire. Exercise: Power of Body Language, Charades.

UNIT-V: Etiquettes

Etiquettes: Greeting Etiquette - Corporate Etiquette - Telephone Etiquette - E-mail Etiquette – Meeting Etiquette - Netiquette - Personal Etiquette - Social Etiquette - Dining Etiquette. Exercise: Introduction and Art of Conversation, Telephonic Activity.

Course Outcomes:

At the end of the course, the students would be able to:

CO-1: Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.

CO-2: Understand and practice different techniques of communication.

CO-3: Practice and adhere to the 7Cs of Communication.

CO-4: Familiarize with different types of Communication.

CO-5: Understand and practice Interview Etiquettes.

CO1	Develop knowledge, skills, and judgment around human communication that facilitate theirability to work collaboratively with others	K1
CO2	Understand and practice different techniques of communication.	K2
CO3	Practice and adhere to the 7Cs of Communication.	K4
CO4	Practice Electrical Safety Rules & standards	K3
CO5	Understand and practice Interview Etiquettes	K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

TEXT BOOKS:

1. Meenakshi Raman and Prakash Singh, Business Communication, Oxford
2. **Lesikar:** Basic Business Communication, TMH
3. **David Irwin:** Effective Business Communications, Viva- Thorogood. Rajendra Pal, J S Korlaha
4. **HI:** Essentials of Business Communication: Sultan Chand & Sons, New Delhi

ENGINEERING MATHEMATICS-II (BT201)

Course objectives:

To enable students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following

- Ordinary differential equations
- Partial differential equations
- Double and triple integration
- Laplace transform

UNIT– I

Linear differential equations with constant coefficients: Solutions of second and higher order differential equations - operator method, method of undetermined coefficients and method of variation of parameters.

UNIT-II

Differential equations-2:

Linear differential equations with variable coefficients: Solution of Cauchy's and Legendre's linear differential equations.

Nonlinear differential equations - Equations solvable for p, equations solvable for y, equations solvable for x, general and singular solutions, Clairauit's equations and equations reducible to Clairauit's form.

UNIT-III

Partial Differential equations:

Formulation of Partial differential equations by elimination of arbitrary constants/functions, solution of non-homogeneous Partial differential equations by direct integration, solution of homogeneous Partial differential equations involving derivative with respect to one independent variable only.

Derivation of one dimensional heat and wave equations and their solutions by

variable separable method.

UNIT-IV

Integral Calculus:

Multiple integrals: Beta and Gamma functions: definitions, Relation between beta and gamma functions and simple problems.

Evaluation of double and triple integrals. Evaluation of double integrals by changing the order of integration and by changing into polar co-ordinates. Applications of multiple integrals to find area and volume.

UNIT-V

Laplace Transform

Definition and Laplace transforms of elementary functions, Linearity, first and second shifting, change of scale.

Laplace transforms of derivatives, integral, multiplication and division by ***t,*** periodic functions.

Inverse Laplace Transform

Inverse Laplace Transform - problems, Convolution theorem to find the inverse Laplace transforms (without proof) and problems, solution of linear differential equations using Laplace Transforms.

Course Outcome

- Solve differential equations of electrical circuits forced oscillation of mass spring and elementary heat transfer.
- Solve partial differential equations of fluid mechanics , electromagnetic theory and heat transfer
- Evaluate double and triple integrals to find area, volume, mass and moment of inertia of plane and solid region.
- Use curl and divergence of a vector valued functions in various applications of electricity, magnetism and fluid flow.

Course Outcomes (COs):

CO1	Solve differential equations of electrical circuits forced oscillation of mass spring and elementary heat transfer.	K1
CO2	Solve partial differential equations of fluid mechanics , electromagnetic theory and heat transfer	K2
CO3	Evaluate double and triple integrals to find area , volume, mass and moment of inertia of plane and solid region.	K4
CO4	Use curl and divergence of a vector valued functions in various applications of electricity, magnetism and fluid flow.	K3

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3	1		1			2	1.66		

Text Books:

1. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers,42nd edition, 2013.
2. Kreyszig, "Advanced Engineering Mathematics " -Wiley, 2013

Reference Books:

1. B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-Hill, 2006
2. N P Bali and Manish Goyal, "A text book of Engineering mathematics" , Laxmi publications, latest edition.

3. H. K Das and Er. Rajnish Verma ,"Higher Engineering Mathematics", S. Chand publishing,1st edition, 2011.

ENGINEERING CHEMISTRY (BT202)

Course objectives:

To provide students with knowledge of engineering chemistry for building technical competence in industries, research and development in the following fields

- Electrochemistry & Battery Technology.
- Corrosion & Metal Finishing.
- Fuels & Solar energy.
- Polymers.
- Water Technology & Nano Materials.

UNIT-I

Electrochemistry and Battery Technology

Electrochemistry: Introduction, Derivation of Nernst equation for electrode potential. Reference electrodes: Introduction, construction, working and applications of calomel and Ag / AgCl electrodes. Measurement of electrode potential using calomel electrode. Ion selective electrode: Introduction; Construction and working of glass electrode, determination of pH using glass electrode. Concentration cells: Electrolyte concentration cells, numerical problems.

Battery Technology: Introduction, classification - primary, secondary and reserve batteries. Characteristics - cell potential, current, capacity, electricity storage density, energy efficiency, cycle life and shelf life. Construction, working and applications of Zinc- Air, Nickel- metal hydride batteries. Lithium batteries: Introduction, construction, working and applications of Li-MnO2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H2SO4 electrolyte.

UNIT-II

Corrosion and Metal Finishing:

Corrosion: Introduction, electrochemical theory of corrosion, galvanic series. Factors affecting the

rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature. Types of corrosion- Differential metal, differential aeration (Pitting and water line) and stress. Corrosion control: Inorganic coatings-Anodizing of Al and phosphating; Metal coatings-Galvanization and Tinning. Cathodic protection (sacrificial anodic and impressed current methods).

Metal Finishing: Introduction, Technological importance. Electroplating: Introduction, principles governing-Polarization, decomposition potential and overvoltage. Factors influencing the nature of electro deposit-current density, concentration of metal ion & electrolyte; pH, temperature & throwing power of plating bath; additives- brighteners, levellers, structure modifiers & wetting agents. Electroplating of Nickel (Watt's Bath) and Chromium(decorative and hard). Electro less plating: Introduction, distinction between electroplating and electro less plating, electro less plating of copper & manufacture of double sided Printed Circuit Board with copper.

UNIT-III

Fuels and Solar Energy:

Fuels: Introduction, classification, calorific value- gross and net calorific values, determination of calorific value of fuel using bomb calorimeter, numerical problems. Cracking: Introduction, fluidized catalytic cracking, synthesis of petrol by Fishcher-Tropsch process, reformation of petrol, octane and cetane numbers., anti knocking agents, power alcohol & biodiesel.

Solar Energy: Introduction, utilization and conversion, photovoltaic cells- construction and working. Design of PV cells: modules, panels & arrays. Advantages & disadvantages of PV cells. Production of solar grade silicon: Union carbide process, purification of silicon (zone refining), doping of silicon-diffusion technique (n&p types).

UNIT-IV

Polymers:

Introduction, types of polymerization: addition and condensation, mechanism of polymerization-free radical mechanism taking vinyl chloride as an example. Molecular weight of polymers: number average and weight average, numerical problems. Glass transition temperature (Tg): Factors influencing Tg-Flexibility, inter molecular forces, molecular mass, branching & cross linking and stereo regularity. Significance of Tg. Structure property relationship: crystallinity, tensile strength, elasticity & chemical resistivity. Synthesis, properties and applications of PMMA (plexi glass), Polyurethane and polycarbonate. Elastomers: Introduction, synthesis, properties and applications

of Silicone rubber.

UNIT-V

Water Technology and Nanomaterials:

Water Technology: Introduction, boiler troubles with disadvantages & prevention methods-scale and sludge formation, priming and foaming, boiler corrosion(due to dissolved O2, CO2 and MgCl2). Determination of DO, BOD and COD, numerical problems on COD. Sewage treatment: Primary, secondary (activated sludge method) and tertiary methods. Softening of water by ion exchange process

Nano Materials: Introduction, properties (size dependent). Synthesis-bottom up approach (sol-gel, precipitation, gas condensation & chemical vapour condensation processes). Nano scale materials-carbon nano tubes, nano wires, fullerenes, dendrimers, nano rods, & nano composites.

Course outcomes:

On completion of this course, students will have knowledge in:

CO-1: Electrochemical and concentration cells. Classical & modern batteries and fuel cells.

CO-2: Causes & effects of corrosion of metals and control of corrosion. Modification of surface properties of metals to develop resistance to corrosion, wear, tear, impact etc. by electroplating and electro less plating.

CO-3: Production & consumption of energy for industrialization of country and living standards of people. Utilization of solar energy for different useful forms of energy.

CO-4: Replacement of conventional materials by polymers for various applications.

CO-5: Boiler troubles; sewage treatment and desalination of sea water.

Course Outcomes (COs):

CO1	Electrochemical and concentration cells. Classical & modern batteries and fuel cells	K1
CO2	Causes & effects of corrosion of metals and control of corrosion. Modification of surface properties of metals to develop resistance to corrosion, wear, tear, impact etc. by electroplating and electro less plating	K2

CO3	Production & consumption of energy for industrialization of country and living standards of people. Utilization of solar energy for different useful forms of energy	K4
CO4	Replacement of conventional materials by polymers for various applications	K3
CO5	Boiler troubles; sewage treatment and desalination of sea water.	K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

Text Books:

1. B.S.JaiPrakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar., **"Chemistry for Engineering Students"**, Subhash Publications,Bangalore.
2. R.V.Gadag & A.Nityananda Shetty., **"Engineering Chemistry"**, I K International Publishing House Private Ltd. New Delhi.
3. P.C.Jain & Monica Jain.,**"Engineering Chemistry"**, Dhanpat Rai Publications, New Delhi.

Reference Books:

1. O.G.Palanna,"Engineering Chemistry",Tata McGraw Hill EducationPvt.Ltd. New Delhi, Fourth Reprint.
2. G.A.Ozin& A.C. Arsenault, "Nanochemistry A Chemical Approach toNanomaterials", RSC publishing, 2005. "Wiley Engineering Chemistry",

Wiley India Pvt. Ltd. New Delhi.SecondEdition

ELEMENTS OF CIVIL ENGINEERING AND MECHANICS(BT203)

Course Objectives:

The objectives of this course is to make students to learn basics of Civil Engineering concepts and infrastructure development, solve problems involving Forces, loads and Moments and know their applications in allied subjects. It is a pre-requisite for several courses involving Forces, Moments, Centroids, Moment of inertia and Kinematics.

UNIT-I: Introduction to Civil Engineering & EngineeringMechanics

Introduction to Civil Engineering

Scope of different fields of Civil Engineering - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering.

Infrastructure: Types of infrastructure, Role of Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities onsocio-economic development of a country. Roads: Classification of Roads and their functions, Comparison of Flexible and Rigid Pavements (Advantages and Limitations)

Bridges: Types of Bridges and Culverts, RCC, Steel and Composite Bridges

Dams: Different types of Dams based on Material, Structural behavior and functionality with simple sketches.

Introduction to Engineering Mechanics: Basic idealizations - Particle, Continuum and Rigid body; Newton's laws-Force and its characteristics, types of forces-Gravity, Lateral and its distribution on surfaces, Classification of force systems, Principle of physical independence, superposition, transmissibility of forces, Introduction to SI units. Couple, Moment of a couple, Characteristics of couple, Moment of a force, Equivalent force - Couple system; Numerical problems on moment of forces and couples, on equivalent force - couple system.

UNIT-II: Analysis of Concurrent Force Systems

Concepts: Resultants and Equilibrium

Composition of forces - Definition of Resultant; Composition of coplanar - concurrent force system, Parallelogram Law of forces, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

Application- Static Friction in rigid bodies in contact

Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes

UNIT-III: Analysis of Non-Concurrent Force Systems

Concepts: Resultants and Equilibrium

Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent Force system.

Application-Support Reaction in beams

Types of Loads and Supports, statically determinate beams, Numerical problems onsupport reactions for statically determinate beams with Point load (Normal and inclined) and uniformly distributed and uniformly varying loads and Moments.

UNIT-IV: Centroids and Moments of Inertia of EngineeringSections:

Centroids

Introduction to the concept, centroid of line and area, centroid of basic geometrical figures, computing centroid for–T,L,I,Z and full/quadrant circular sections and their built up sections. Numerical problems

Moment of Inertia

Introduction to the concept, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of basic planar figures, computing moment of Inertia for – T, L, I, Z and full/quadrant circular sections and their built up sections. Numerical problems.

UNIT-V: Kinematics

Concepts and Applications

Definitions – Displacement – Average velocity – Instantaneous velocity – Speed – Acceleration - Average acceleration – Variable acceleration – Acceleration due to gravity – Newton's Laws of Motion.

Rectilinear Motion–Numerical problems.

Curvilinear Motion – Super elevation – Projectile Motion – Relative motion – Numerical problems.

Motion under gravity – Numerical problems.

Course outcomes

CO-1: Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges andDams;

CO-2: Comprehend the action of Forces, Moments and other loads on systems of rigid bodies;

CO-3: Compute the reactive forces and the effects that develop as a result of the external loads

CO-4: Locate the Centroid and compute the Moment of Inertia of regular cross- sections.

Course Outcomes (COs):

CO1	Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges andDams	K1
CO2	Comprehend the action of Forces, Moments and other loads on systems of rigid bodies	K2
CO3	Compute the reactive forces and the effects that develop as a result of the external loads	K4
CO4	Locate the Centroid and compute the Moment of Inertia of regular cross- sections	K3

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

TEXT BOOKS

1. Elements of Civil Engineering and Engineering Mechanics by M.N. Shesha Prakash and Ganesh. B. Mogaveer, PHI Learning, 3rd Revised edition (2014)

2. Engineering Mechanics-Statics and Dynamics by A Nelson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.

3. Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.

REFERENCE BOOKS

1. Engineering Mechanics by S.Timoshenko, D.H.Young, and J.V.Rao, TATA McGraw-Hill Book Company, New Delhi
2. Beer FP and Johnson ER, "Mechanics for Engineers- Dynamics and Statics"- 3rd SI Metric edition, Tata McGraw Hill. - 2008

COMPUTER AIDED ENGINEERING DRAWING (BT204)

Course objectives:

- Engineering drawing is an important tool for all Engineers and for many others professionals. It is the language of Engineers. Engineering Drawing communicates all needed information from the engineer who designed a part to the workers who will manufacture it.
- The aim of the subject is to equip students with the fundamentals of Computer Aided

Engineering Drawing and to further the ability to communicate information by graphical means.

UNIT-I

Introduction to Computer Aided Sketching

Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. of HP, VP, RPP & LPP. of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.

UNIT -II

Orthographic projections

Introduction to Orthographic projections. Conversion of pictorial view into Orthographic Views (First Angle Projection Method Only). Dimensioning technique as per SP-46. Conversion of orthographic views into isometric View/projection (Simple objects). Projection of Straight Lines and Planes. (First Angle Projection Method Only). Lines inclined to one reference plane only and limited to both ends in One quadrant.

UNIT-III

Projections of Planes (First angle Projection only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders andcones in different positions

UNIT-IV

Projections of Solids (First angle Projection only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube),

prisms, pyramids, cylinders and cones in different positions (No problems on octahedrons and combination solid).

UNIT-V

Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of three solids).

Course outcomes:

CO-1: Students will be able to demonstrate the usage of CAD software.

CO-2: Students will be able to visualize and draw Orthographic projections, Sections of solids and Isometric views of solids.

CO-3: Students are evaluated for their ability in applying various concepts to solve practical problems related to engineering drawing.

CO-4: Students will able to draw their visualization through various softwares.

Course Outcomes (COs):

CO1	Students will be able to demonstrate the usage of CAD software	K1
CO2	Students will be able to visualize and draw Orthographic projections, Sections of solids and Isometric views of solids.	K2
CO3	Students are evaluated for their ability in applying various concepts to solve practical problems related to engineering drawing.	K4
CO4	Students will able to draw their visualization through various softwares.	K3

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			

CO Average	2.66	2	3			1			2	1.66		

TEXT BOOKS:

1. Engineering Drawing – N.D. Bhatt & V.M. Panchal, 48th edition, 2005 Charotar Publishing House, Gujarat.

2. "Computer Aided Engineering Drawing"by Dr. M H Annaiah, Dr C N Chandrappa and Dr B Sudheer Premkumar Fifth edition, New Age International Publishers

REFERENCE BOOKS:

1. Computer Aided Engineering Drawing – S. Trymbaka Murthy, - I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition-2006.

2. Engineering Graphics - K.R. Gopalkrishna, 32nd edition, 2005- Subash Publishers Bangalore

Basic Electronics (BT205)

Course Objectives:

- To study in detail about construction of several electronic devices.
- To analyse the characteristics of various electronic devices and circuits.
- To understand the internal structure and characteristics of Op-amp.
- To learn about the linear and non-linear applications of Op-amp.

UNIT-I: Semi Conductors and Diodes:

Conductors, Semiconductors, Intrinsic Semiconductors, Extrinsic Semi-Conductors. Diode Theory: Basic Ideas, The ideal Diode, Forward and Reverse Bias, Diode Equation, Volt-Ampere Characteristic. Special diodes: symbol of zener diode, operation, V-I characteristics, symbol of photo diode, working principle, LED symbol and principle.

Hours- 10

UNIT-II: Rectifiers:

Half-wave Rectifier, Full-wave and Bridge Rectifier, derivation of Ripple factor, efficiency of Half-wave, full-wave and Bridge rectifiers. Merits and demerits of Half-wave, full-wave and Bridge rectifiers, Comparisons of rectifiers.

Hours- 10

UNIT-III: Bipolar Junction Transistors:

Symbols of pnp and npn transistors and their working principles, Transistor currents, input and output characteristics of Common base configuration, Common Emitter configuration Transistor Switch, Amplifiers: working principles of Common base amplifier, Common Emitter amplifier, Common collector amplifier and their applications.

Hours- 10

UNIT-IV: Characteristics of Op-Amps:

Introduction to OP-amp, Op-amp Block Diagram, ideal and practical Op-amp specifications, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put off set voltages & currents, slew rates, CMRR, PSRR.

Hours- 7

UNIT-V: Applications of Op-Amps:

Inverting and Non-inverting amplifier, Integrator and differentiator, Comparators.

Hours- 3

Course Outcomes:

Students will be able to

CO-1: Understand the semiconductor physics of the intrinsic, p and n materials.

CO-2: Understand the function and operation of diodes, transistors and amplifiers.

CO-3: Students will be aware of the architecture, functions & their applications of IC 741 OP-Amp

CO-4: Students will be aware of the material used in manufacturing of semiconuctors.

Course Outcomes (COs):

CO1	Understand the semiconductor physics of the intrinsic, p and n materials	K1
CO2	Understand the function and operation of diodes, transistors and amplifiers.	K2
CO3	Students will be aware of the architecture, functions & their applications of IC 741 OP-Amp.	K4
CO4	Students will be aware of the material used in manufacturing of semiconuctors	K3

CO–PO Mapping Matrix:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

Outcome												
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

Text Books:

1. Electronic Principles, Albert Malvino and David J Bates, 7th Edition, Tata McGraw –Hill.

2. Electronic Devices and Circuits Theory, Boyelstad, Pearson Education, 8th Edition, September 2011.

B.Tech. MINING Engineering.

3. Op-Amps and Linear Integrated Circuits , - Ramakanth A. Gayakwad, PHI, 4th Edition, 2009

4. Linear Integrated Circuits – D. Roy Chowdhury, New Age International Pvt.Ltd.,

2nd Edition, 2003.

SOFTWARE ENGINEERING (BT206)

Course Objectives:

- Understand the software life cycle models
- Understand the importance of the software development process
- Understand the importance of modeling and modeling languages
- Design and develop correct and robust software products

UNIT-I

Introduction:

Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT-II

Software Requirement Specifications (SRS) Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

UNIT III

Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

UNIT-IV

Software Maintenance and Software Project Management Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Course Outcomes:

At the end of the course the student should be able to:

CO 1: Identify the need for engineering approach to software development and various processes of requirements analysis for software engineering problems.

CO 2: Analyze various software engineering models and apply methods for design and developmentof software projects.

CO 3: Work with various techniques, metrics and strategies for Testing software projects.

CO 4: Identify and apply the principles, processes and main knowledge areas for Software Project Management.

CO 5: Proficiently apply standards, CASE tools and techniques for engineering software projects

Course Outcomes (COs):

CO1	Identify the need for engineering approach to software development and various processes of requirements analysis for software engineering problems	K1
CO2	Analyze various software engineering models and apply methods for design and developmentof software projects	K2
CO3	Work with various techniques, metrics and strategies for Testing software projects.	K4
CO4	Identify and apply the principles, processes and main knowledge areas for Software Project Management.	K3
CO5	Proficiently apply standards, CASE tools and techniques for engineering software projects.	K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

Text books:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.

4. Pankaj Jalote, Software Engineering, Wiley 5.Deepak Jain,"Software Engineering:Principles and Practices", Oxford University Press.

PROBABILITY AND STATISTICS & COMPLEX VARIABLES (BTMN301)

Course Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probabilitydistributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper the student must be able to

CO 1. Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

CO 2. Analyse the complex function with reference to their analyticity, integration using Cauchy's integraland residue theorems.

CO 3. Taylor's and Laurent's series expansions of complex function.

Course Outcomes (COs):

CO1	Formulate and solve problems involving random variables and apply statistical methods foranalysing experimental data.	K1
CO2	Analyse the complex function with reference to their analyticity, integration using Cauchy's integraland residue theorems.	K2
CO3	Taylor's and Laurent's series expansions of complex function	K4

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		

CO2	2			1		1			3	3		
CO3	3									1		
CO Average	2.66	2	3			1			2	1.66		

UNIT - I: Basic Probability

Probability spaces, conditional probability, independent events, and Bayes' theorem.

Random variables: Discrete and continuous random variables, Expectation of Random Variables,Moments, Variance of random variables.

HOURS 8

UNIT - II: Probability distributions

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation tothe binomial distribution

Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

HOURS 10

UNIT - III: Testing of Hypothesis

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, levelof significance, critical region.

Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances.

HOURS 10

UNIT - IV: Complex Variables (Differentiation)

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

HOURS 10

UNIT - V: Complex Variables (Integration)

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

HOURS **10**

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statisticsfor engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.

REFERENCE BOOKS:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.

FLUID MECHANICS & HYDRAULIC MACHINES (BT MN302)

Course Objectives: The objectives of the course are to enable the student;

- To understand the basic principles of fluid mechanics
- To identify various types of flows
- To understand boundary layer concepts and flow through pipes
- To evaluate the performance of hydraulic turbines
- To understand the functioning and characteristic curves of pumps

Course Outcomes:

CO 1. Able to explain the effect of fluid properties on a flow system.

CO 2. Able to identify type of fluid flow patterns and describe continuity equation.

CO 3. To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanicsprinciples in design.

CO 4. To select and analyze an appropriate turbine with reference to given situation in power plants.

CO 5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

CO 6. Able to demonstrate boundary layer concepts.

Course Outcomes (COs):

CO1	Able to explain the effect of fluid properties on a flow system.	K1
CO2	Able to identify type of fluid flow patterns and describe continuity equation.	K2
CO3	To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanicsprinciples in design.	K4
CO4	To select and analyze an appropriate turbine with reference to given situation in power plants.	
CO5	To estimate performance parameters of a given Centrifugal and Reciprocating pump.	
CO6	Able to demonstrate boundary layer concepts.	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surfacetension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

HOURS **10**

UNIT - II

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

HOURS **10**

UNIT - III

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: Pitot tube,venturi meter, and orifice meter, Flow nozzle.

HOURS **10**

UNIT - IV

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulicdesign –draft tube theory- functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

HOURS **10**

UNIT - V

Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

HOURS **10**

TEXT BOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

MECHANICS OF SOLIDS (BT MN303)

Course Objectives:

- Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
- Students will be able to understand and know how to calculate stresses and deformation of abar due to an axial loading under uniform and non-uniform conditions.
- Students will understand how to develop shear-moment diagrams of a beam and find themaximum moment/shear and their locations
- Students will understand how to calculate normal and shear stresses.

Course Outcomes:

CO 1. Analyze the behavior of the solid bodies subjected to various types of loading;

CO 2. Apply knowledge of materials and structural elements to the analysis of simple structures;

CO 3. Undertake problem identification, formulation and solution using a range of analytical methods;

CO 4. Analyze and interpret laboratory data relating to behavior of structures and the materials they aremade of, and undertake associated laboratory work individually and in teams.

CO 5. Expectation and capacity to undertake lifelong learning.

Course Outcomes (COs):

CO1	Analyze the behavior of the solid bodies subjected to various types of loading;	K1
CO2	Apply knowledge of materials and structural elements to the analysis of simple structures;	K2
CO3	Undertake problem identification, formulation and solution using a range of analytical methods;	K4
CO4	Analyze and interpret laboratory data relating to behavior of structures and the materials they aremade of, and undertake associated laboratory work individually and in teams.	
CO5	Expectation and capacity to undertake lifelong learning	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

UNIT – I

Simple Stresses & Strains: Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress

– strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II

Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beamssubjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams

sections like rectangular, circular, triangular, I, T angle sections.

UNIT – IV

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses.

– Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses

– Principal stresses and strains – Analytical and graphical solutions.

Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT - V

Torsion of Circular Shafts: Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\theta/L$

– Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

TEXT BOOKS:

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash, TMH

REFERENCE BOOKS:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar

Publishing HousePvt. Ltd.

4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

MINE SURVEYING (BT MN304)

Course Objectives: To introduce various technologies of surveying on the surface and underground mining situations including distance measurements, leveling, contouring, traversing etc along with descriptions of associated instruments.

Course Outcomes:

CO 1. Analyze the behavior of the surveying subjected to various types of applications

CO 2. Apply knowledge of materials and structural elements to the analysis of simple structures;

CO 3. Undertake problem identification, formulation and solution using a range of analytical methods;

CO 4. Analyze and interpret laboratory data relating to behavior of structures and the materials they aremade of, and undertake associated laboratory work individually and in teams.

CO 5. Expectation and capacity to undertake lifelong learning

Course Outcomes (COs):

CO1	Analyze the behavior of the surveying subjected to various types of applications;	K1
CO2	Apply knowledge of materials and structural elements to the analysis of simple structures;	K2
CO3	Undertake problem identification, formulation and solution using a range of analytical methods;	K4
CO4	Analyze and interpret laboratory data relating to behavior of structures and the materials they aremade of, and undertake associated laboratory work individually and in teams.	
CO5	Expectation and capacity to undertake lifelong learning	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Introduction: overview of Plane Surveying (Chain, compass, and plane table-in brief): Objectives, Principles and classifications; electronic distance measurements; Types of compasses, different types of meridians and bearings, local attraction and closed traversing with compass; computation of anglesfrom bearings; declination.

Global Positioning System: Introduction to Global Information System (GIS), Remote Sensing – basic Principles, Integration of RS, GIS and Laser scanning.

Total Station: Description, uses, types of surveys by total station, mapping of sites by total station surveys – elementary exercises only.

UNIT - II

Levelling: Different types leveling instruments and description of parts; Temporary and Permanent adjustments; methods of levelling – fly levelling, differential levelling, and reciprocal levelling. Problemson leveling. Permissible error and distribution of error.

Contouring: Characteristics and uses of contour; contour interval; methods of establishing contours.

UNIT - III

Theodolite – description of parts; Temporary and Permanent Adjustments, Measurement of horizontal and vertical angles, Principles of Electronic Theodolite, Trigonometric levelling. Tacheometry Traversing with Theodolite: Principles of traversing, open traverse and closed traverse using theodolite; Latitude and Departure: consecutive co-ordinates/ dependent co-ordinates and independent co- ordinates/ total coordinates; closing error and correction in closed traversing by different methods- Bowditch method, transit method. Triangulation: Principles and methods of triangulation: classification of triangulation system, signals and towers; base line measurement; calculations of length of base- tape corrections. Astronomical surveying. Center line and gradient control of inclines. Center line of sinking and raising Shafts. Surveying and preparation of slope planes etc. Duties and responsibilities of surveyors. Errors in mine plans and their corrections. Calculation of volumes. Introduction to surveyingsoftwares.

UNIT - IV

Computation of Areas and Volumes: Areas from field notes, computation of Areas along irregular boundaries and regular boundaries. Embankments and cuttings, determination of capacity of reservoir/volume. Tacheometric Surveying: – Principles, Stadia and tangential methods, measurements of heights and distances by tacheometry, distance and elevation formulae for staff vertical and normal; anallactic lens. Curves: Definitions and types of curves; simple curves by linear and angular method (Rankine's method); setting of underground curve.

UNIT - V

Mine Surveys: Verticality of shaft, measurement of depth of shaft. Correlation Survey: classification and purposes of correlation survey; different methods- single shaft (co-plantation method, weissbach triangle method) and two shaft (Weiss quadrilateral method)
Miscellaneous: EDM and modern instruments, open pit surveys, mine plans and sections, Statutory requirements.

TEXT BOOKS:

1. Surveying (Vol-1, 2 & 3) by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain- LaxmiPublications (P) Ltd., New Delhi.
2. Surveying (Vol 1 & 2) – Kanitkar

REFERENCE BOOKS:

1. Arthur R. Benton and Philip J Taetly, Elements of Plane Surveying, McGraw Hill-2000
2. Arora K R Surveying Vol 1 & 2 & 3, Standard Book House, Delhi, 2004.
3. Chandra A M, Plane Surveying, New age International Pvt. Ltd., Publishers, New Delhi, 2002.
4. Chandra A M, Higher Surveying, New age International Pvt. Ltd, Publishers, New Delhi, 2002.

DEVELOPMENT OF MINERAL DEPOSIS (BT MN305)

Course Objective:

Course introduces underground and surface mining methods along with the associated activities such as drilling, blasting, supporting etc for mines. Modes of entry into the underground mines with special emphasis on various shaft sinking methods for development of mineral deposits are also described.

Course Outcomes:

CO 1. Students can understand the fundamentals of drilling and blasting techniques for underground and opencast mines which can be put in practice later in the concerned mining industries.

CO 2. As deep underground mining is inevitable in near future, students must play on active role in participating in various activities like arrangement for sinking, ventilation, lighting etc.

Course Outcomes(COs):

CO1	Students can understand the fundamentals of drilling and blasting techniques for underground and opencast mines which can be put in practice later in the concerned mining industries.	K1
CO2	As deep underground mining is inevitable in near future, students must play on active role in participating in various activities like arrangement for sinking, ventilation, lighting etc.	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Historical overview of mining, evaluation of mining and mining machinery/Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology, stages in the life of the mine, introduction to underground and surface mining methods. Positive and negative aspects of mining. Role of mining engineers in mining industry. Various statutes applicable in mining. Stages in a life of a mine. Role of statutory bodies like DGMS, IBM, PESO, MOEF etc., Introduction to seabed mining. Brief procedure of obtaining mining leases.

UNIT - II

Introduction to drilling and drilling equipment. Fundamentals of explosive and blasting techniques.

UNIT - III

Objectives and limitations of mine supports, hydraulic props, Roof bolts, chock supports, Roadway support, face supports, side supports, junction supports, supports in special conditions, setting and withdrawal of supports, systematic supporting rules.

UNIT - IV

Modes of entry into deposits for underground mining- shafts, inclines, adits etc – their fields of applications. Drivage of drifts, organization and cycle of operations, modern methods of drifting and tunneling, road headers, tunnel boring.

UNIT - V

Location of shaft, shape and size, incline and vertical shafts. Surface arrangements for sinking shafts,tools and equipments, ordinary methods of sinking, drilling, blasting, removal of debris and water, ventilation and lighting, temporary and permanent lining. Widening and deepening of shafts, special methods of shaft sinking: piling, caisson, freezing and cementation method of shaft sinking. Modern techniques of shaft sinking like shaft boring, shaft raising.

TEXT BOOKS:

1. Introductory mining engineering- Wiley India (P) Ltd, Howard L. Hartman, Jan M. Mutmansky.
2. Elements of mining technology Vol-I - D.J. Deshmukh

REFERENCE BOOKS:

1. Roy Pijush Pal, Blasting in ground excavations and mines, Oxford and IBH, 1st ed 1993
2. C.P. Chugh, Drilling technology handbook, Oxford and IBH, 1st ed, 1977

CONSTITUTION OF INDIA (BT MN306)

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and

economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

UNIT-I

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India

UNIT-II

4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation

UNIT-III

7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure

UNIT-IV

10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India

UNIT-V

13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

MINE SURVEYING – I LAB (BT MN307L)

Course Objectives:

To familiarize with the various surveying instruments and methods.

Course Outcomes: At the end of the course, students will be able to

CO 1. Do the range between the two points and measure the distance between two points

CO 2. Conduct the chain triangulation survey

CO 3. Determine the area by using different methods.

CO 4. Determine the elevation of a given point.

CO 5. Use the instruments used in the surveying.

Course Outcomes (COs):

CO1	Do the range between the two points and measure the distance between two points	K1
CO2	Conduct the chain triangulation survey	K2
CO3	Determine the area by using different methods.	K4
CO4	Determine the elevation of a given point.	K3
CO5	Use the instruments used in the surveying.	K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		

CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

LIST OF EXPERIMENTS:

1. Ranging a line, measuring the distance between two points, pacing.
2. Chain triangulation, booking, calculation of areas and plotting.
3. Traversing with compass.
4. Introduction to levels.
5. Fly leveling & Reduction of level.
6. Profile leveling and plotting the section.
7. Contouring
8. Measurement of Horizontal angle.
9. Measurement of vertical angle.
10. Theodolite traversing
11. Finding distance between two inaccessible points

FLUID MECHANICS & HYDRAULIC MACHINES LAB (BT MN308L)

Course Objectives:

To understand the basic principles of fluid mechanics.

To identify various types of flows.

To understand boundary layer concepts and flow through pipes.

To evaluate the performance of hydraulic turbines.

To understand the functioning and characteristic curves of pumps.

Course Outcomes:

CO 1. Able to explain the effect of fluid properties on a flow system.

CO 2. Able to identify type of fluid flow patterns and describe continuity equation.

CO 3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanicsprinciples in design.

CO 4. To select and analyze an appropriate turbine with reference to given situation in power plants.

CO 5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

Course Outcomes (COs):

CO1	Able to explain the effect of fluid properties on a flow system.	K1
CO2	Able to identify type of fluid flow patterns and describe continuity equation.	K2
CO3	To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanicsprinciples in design.	K4
CO4	To select and analyze an appropriate turbine with reference to given situation in power plants.	K3
CO5	To estimate performance parameters of a given Centrifugal and Reciprocating pump.	K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli's Theorems.

MINING GEOLOGY (BT MN401)

Course Objectives: This course is aimed at providing the necessary geological inputs required for a mining engineer. The components would help the mining engineering student to understand the identification of important minerals and rocks, strengths and weaknesses of rocks, physical and mechanical properties of rocks and the response of rocks to loading and excavation. The knowledge pertaining to the genesis of mineral deposits, mineral exploration, ore reserves estimation and mineralresources of India are of immense use in the mining engineering practice. A mining engineer should learn geology thoroughly since his profession would require him to know the methods of mining and different types of underground openings.

Course Outcomes:

CO 1. Students will gain the skills to identify the geological problems, hazards, and phenomenaoccurring in the mining practice.

CO 2. Students can understand the origin of mineral deposits, techniques of mineral exploration andestimation of mineral resources as outcome of this course.

Course Outcomes (COs):

CO1	Students will gain the skills to identify the geological problems, hazards, and phenomenaoccurring in the mining practice.	K1
CO2	Students can understand the origin of mineral deposits, techniques of mineral exploration andestimation of mineral resources as outcome of this course.	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Introduction: Branches of Geology useful to mining engineering and scope of geological studies in various mining engineering projects.

Mineralogy: Physical properties, chemical composition, mode of occurrence and uses of important rock-forming, ore-forming and industrial minerals- Quartz, Feldspars, Olivine, Augite, Hornblende, Micas, Calcite, Dolomite, Kaolinite, Illite, Montmorillonite, Talc, Chlorite, Garnet, Kyanite, Hematite, Magnetite, Gypsum, Bauxite, Graphite, Corundum, Chromite, Magnesite, Barytes, Apatite, Chalcopyrite, Pyrite, Sphalerite, and Galena.

Petrology: Origin/mode of formation, mineral composition, textures and structures and mode of occurrence of important igneous, sedimentary and metamorphic rocks - Granite, Rhyolite, Gabbro, Dolerite, Basalt, Pegmatite, Syenite, Trachyte, Laterite, Conglomerate, Breccia, Sandstone, Shale, Limestone, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble, Khondalite and Charnockite.

Engineering properties of rocks: Physical and mechanical properties of rocks, stress-strain behaviour of rocks under uniaxial compression, factors controlling the strength of rocks, numerical values and constructional uses of rocks.

UNIT - II

Rock weathering: Definition, rate of weathering, processes of weathering, end products of weathering, susceptibility of rocks to weathering, assessment of the degree and depth of weathering, classificationof weathering.

Geology of soils: Genesis/origin, profile of the soils, Geological classification and description of soils,soil conservation with reference to mining and major soil groups of India.

Land forms: Mode of formation/origin, characteristic features and engineering considerations of erosional and depositional land forms of alluvial, aeolian, glacial and marine.

UNIT - III

Structural Geology: Strike and Dip, outcrop, Fundamental types, characteristic features, field criteria, mechanics and engineering considerations of folds, faults, joints (discontinuities) and unconformities. Foliation and lineation.

Ground Water: Hydrologic cycle, water table, vertical distribution of ground water, types of aquifers, Geologic formations as aquifers, springs, ground water movement, ground water exploration and ground water control.

UNIT - IV

Economic Geology: Definitions of ore, gangue, tenor/grade of ore. Processes and formation of oredeposits. Geological time scale, metallogenic epochs and provinces.

Mineral Exploration: Geological, Geophysical, Geochemical and remote sensing methods of mineralexploration.

Mineral Economics: Estimation and determination of mineral resources and reserves by classical andmodern methods.

Mineral Resources of India: Major and Minor mineral resources of India, Brief description of origin,environment and distribution of mineral deposits of India.

UNIT - V

Geology of Tunnels: Purpose, Stand-up time of different rock mass classes, Engineering geological investigations (litho logical, structural, groundwater, geophysical and borehole

drilling) to drive tunnels in soft and hard ground, geology of some well-known tunnels of India, problems in tunnelling and theirsolutions.

Mining Methods: Geological factors to be considered in the selection of alluvial mining/ surface mining,quarrying, open-cast mining and underground mining; **Role** of Geology in the opening of Shafts and Inclines.

TEXT BOOKS:

1. Peters, W. C. Exploration and Mining Geology (2nd Ed.); 1987. John Wiley & Sons, New York.
2. P.K. Mukerjee, A Text Book of Geology (13th Ed.); 1997. Reprinted 2018, The World PressPvt. Ltd. Kolkata.
3. RNP Arogyaswamy, Courses in Mining Geology (Fourth Edition) 1995, Reprint, 2017,OXFORD & IBH; CBS Publishers & Distributors Pvt. Ltd

REFERENCE BOOKS:

1. Geology and Mineral Resources of India, Misc. Publication No. 30, Part- XXII,
2. Geological Survey of India, 2010.
3. Mining Geology by Hugh Exton Mc Kinstry, 1948, Asia Publishing House (1960)
4. Geological Methods in Mineral Exploration and Mining by Roger Marjoribanks, Springer 2nd Ed.2010.
5. Introduction to Mineral Exploration, Second Edition, Edited by Charles J. Moon, Michael K. G.Whateley & Anthony M. Evans.

MINE PLANNING AND DESIGN (BT MN402)

Course Objectives:

- To understand the planning of opencast & underground mines and equipment utilization.
- To study project implementation and monitoring

Course Outcomes:

CO 1. The students will have knowledge on planning of opencast mining, underground mining and equipment utilization.

CO 2. They will also know about project implementation and monitoring methods.

Course Outcomes (COs):

CO1	The students will have knowledge on planning of opencast mining, underground mining and equipment utilization.	K1
CO2	They will also know about project implementation and monitoring methods	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Introduction: Technical factors in mine planning, methodology of mine planning, short range & long range, Optimization Techniques in Mine Planning; mine plan preparation; Choice between surface andunderground mining.

UNIT - II

Opencast Mining: Development of Ultimate Pit Configuration (open pit limits) and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm and computer assisted hand method; Selection of initial mine cuts and geometrical considerations; location of surface structures, division of mining area into blocks, mine design, Impact of various parameters like depth, dip, stripping ratio, geology and strength of mineral and overburden on mine planning; Selection of Mining Systems;Determination of optimum mine size and sequencing by nested pits; Lanes algorithm for estimation of optimum mill grade and production planning; calendar plan, production scheduling, economic productivity indices. Quality Control-Ore Blending; Planning for mine closure.

UNIT - III

Underground Mining: Design of mine entries – shafts, inclines, design of stopes – size, level interval, etc, design of coal mining district, mine boundaries; design of shaft pillars and protective pillars, planning of production capacity , optimization of mine size – mine production capacity, layout of development drives / raises / winzes etc, length of faces, etc, planning of support systems, ventilation, layout of drainage system; Production planning & Production scheduling, selection of depillaring / stoping method, manpower management economic/ productivity indices, Productivity and quality control; Techno- economic analysis, Planning for mine closure.

UNIT - IV

Equipment Planning: Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment, their capacities and population for different mining conditions. Maintenance planning and scheduling including spare management; Equipment information – performance monitoring and expert systems.

UNIT V

Project Implementation and Monitoring: Pre-project activities – feasibility report, environmental clearance, detailed project report, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Environmental impact assessment and preparation of environmental management plan.

TEXT BOOKS:

1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design,Elsevier, 1995.

REFERENCE BOOKS

1. Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.

2. Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.
3. Christoper J. Bise, Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy,and Exploration, 2003.
4. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.

MINE MECHANIZATION – I (BT MN403)

Course Objectives:

To extract and transport the minerals to the required processing unit/ utilization point variety of machinesare used in the mining industry**.** In this course the student gets acquainted with a few machinery including brief details of the machine parts, their working principles, operation and maintenance in addition to the machine installation, commissioning and safety aspects.

Course Outcomes:

CO 1. After going through this course, the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz., different types of rope haulages, mine locomotives, conveyors, laying of rail tracks for rope haulages and locomotives.

CO 2. In addition, he gains knowledge of the prime movers for the machinery and power transmission mechanisms.

Course Outcomes (COs):

CO1	After going through this course, the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz., different types of rope haulages, mine locomotives, conveyors, laying of rail tracks for rope haulages and locomotives.	K1
CO2	In addition, he gains knowledge of the prime movers for the machinery and power transmission mechanisms.	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Prime Movers for Mining Machinery: I.C. engines, hydraulic power, pneumatic power, elements of mechanical power transmission, Types of couplings, clutches, brakes, gear drives, belt drives, chain drives-advantages and limitations of each drive

UNIT - II

Rope haulage: Construction of the wire ropes, rope haulages – gravity, direct, balanced direct, main & tail, endless. Suitability of these haulages and their limitations. Dimension of ropes and their calculations, drums and pulleys, care and maintenance of ropes, changing of haulage ropes, rope splicing, safety appliances on haulage road, signaling, Statutory requirements of haulages. Haulage calculations for different types of haulage including gravity type. Electrical layout of haulages. Pit top and pit bottom layouts for rope haulages.

UNIT - III

Track Laying: Rail, joints, crossings, plates, turn tables and curves, track extension,

Aerial Ropeways: Types, construction, operation, Applications, advantages and limitations.

UNIT - IV

Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley- wire locomotives- operation, application, advantages and limitations. Comparison of various haulages and locomotives. Numerical problems in locomotion. Conveyors: Belt Conveyors and Chain Conveyors- Types, their installation, operation, shifting, maintenance, applicability and limitations. Vibration and shaking conveyors with their fields of applications. High angle Conveyors in open cast mines (in brief), Stage loader in long wall mining (in brief). Numerical problems in conveying.

UNIT - V

Compressed air generation and applications. Types of air compressors, reciprocating and rotary compressors like roots blower, vane type, centrifugal, axial flow, screw type-operation, maintenance, application, advantages and limitations. Distribution of compressed air, application of compressed air in Mining machinery, maintenance of compressed air, distribution systems.

TEXT BOOKS

1. Elements of Mining Technology Vol. III, D.J. Deshmukh
2. Mine Transport – Karelin

REFERENCE BOOKS:

1. Mining and Transport – Walker.
2. Introduction to Mining Engineers – Hartman. H.L.

DRILLING AND BLASTING (BT MN404)

Course Objectives:

To familiarize the students with exploratory and production drilling including the factors affecting drilling;Various types of the explosives and blasting techniques used in underground and opencast mining arealso explained besides blasting in civil constructions projects.

Course Outcomes:

CO 1. Drilling and blasting is primary operation in any mining organization, student understands various methods of drilling, design and selection of drilling methods.

CO 2. Knowledge about explosives and blasting techniques, makes student confident in design of blasting operations in the field.

Course Outcomes (COs):

CO1	Drilling and blasting is primary operation in any mining organization, student understands various methods of drilling, design and selection of drilling methods.	K1
CO2	Knowledge about explosives and blasting techniques, makes student confident in design of blasting operations in the field	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Exploratory Drilling: Drilling for exploration and other purposes; diamond drilling-equipment and principal of operation, it's merits, demerits and limitations; core recovery — single,double and triple tube core barrels; wire line drilling; directional drilling; fishing tools; borehole surveying; borehole logging; novel and special drilling techniques, Horizontal and directional drilling.

UNIT - II

Production Drilling: Various methods and mechanics of drilling -percussive, rotary and rotary percussive.Jack hammer drilling, Top hammer and Down the Hole (DTH) hammer and rotary drills.

Drillability: Drilabilty studies**,** Factors affecting drilling- operational parameters (like air pressure, thrust, r.p.m., flushing, bit type and bit geometry etc.) and physico-mechanical properties (like strength properties, hardness, abrasivity etc.) design and selection of drills and drill bits; bit wear and reconditioning of drill bits; drilling economics.

UNIT - III

Explosives: Classification and properties of explosives, Types of explosives – Permitted type and their importance, slurry explosives, SMS and PMS, ANFO, LOX, boosters, blasting agents. Mechanics of blasting, alternatives to explosives.

Accessories and Tools: Accessories- different types of detonators, safety fuses, detonating cords, relays, NONEL, exploders, sequential blasting machines and other shot firing tools, testing of explosives, storage, transportation and handling and destruction of explosives and

accessories.

UNIT - IV

Underground Blasting: Drill patterns for underground excavations (for both coal and metal) and in shafts and tunnels; solid blasting; VCR blasting, smooth blasting, induced blasting, charge ratios, rock fragmentation, dangers associated with underground blasting, blasting economics, gallery blasting, statutory requirements, computer design of underground blast, precautionary measures, misfires, blown out shot and blasting economics.

UNIT - V

Open Pit Blasting: Blasting in opencast mines, blast design, primary and secondary blasting; accidentsdue to blast in opencast mines and preventive measures; environmental impacts due to blasting- ground vibrations, fly rocks, dust, fumes, water pollution etc. Dimension stone blasting, controlled blasting, computer design of opencast blast; statutory requirements. Introduction to different blasting and fragmentation analysis softwares, blasting economics. Blasting for Civil Constructions and Trenches: Blasting for road constructions, trench cutting in soft and hard rocks, demolition of buildings, underwater blastings etc. Introduction to blasting instruments like VOD probe, vibration etc. And high speed under cover etc.

TEXT BOOKS:

1. Roy Piush Pal, Blasting in ground excavations and mines, Oxford and IBH, 1st ed 1993.
2. C.P. Chugh, Drilling technology handbook, Oxford and IBH, 1st edn, 1977.

REFERENCE BOOKS:

1. Roy Piush Pal, Rock blasting effect and operation, A.A. Balkema, 1st ed, 2005.
2. D.J. Deshmukh, Elements of mining technology, Vol-1, Central techno, 7th ed, 2001.
3. B. Hemphill Gary, Blasting operations, Mc-Graw Hill, 1st ed 1981.
4. R.D. Singh, Principles and practices of modern coal mining, New age International, 1st edn,1977.

MINE ENVIRONMENTAL ENGINEERING – I (BT MN405)

Course Objectives: In view of very difficult /uncomfortable environment envisaged in deeper mines in future, this course aims at sampling and analysis of mine air, understanding of heat, humidity, distribution of air, natural ventilation etc for underground mines. Mechanical ventilation devices including auxiliary fans, booster fans etc are also covered in this course.

Course Outcomes:

CO 1. Student can understand the ventilation requirements for ground mines including selection of mine fans, ventilation planning, ventilation surveying etc. For any underground mine, ventilation officer is a statutory post as per Indian Mining Law.

CO 2. This course facilitates the required knowledge to perform the duties of ventilation planning effectively.

Course Outcomes (COs):

CO1	Student can understand the ventilation requirements for ground mines including selection of mine fans, ventilation planning, ventilation surveying etc. For any underground mine, ventilation officer is a statutory post as per Indian Mining Law.	K1
CO2	This course facilitates the required knowledge to perform the duties of ventilation planning effectively	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT - I

Atmospheric air-its composition, mine air – its composition and variation, origin, occurrence, physical, chemical and physiological properties and monitoring of mine gases, various types of damps. Sampling and analysis of mine air. Methane drainage and methane layering of gases. Ventilation Air Method (VAM), Cowords diagram, Flame safety lamp monitoring system.

UNIT - II

Heat and humidity: Sources of heat in mines, effect of heat and humidity, psychometric, kata thermometer, methods of improving of cooling power of mine air. Air conditioning basic vapour cycle, representative layout. Air flow through mine openings: Laws of air flow, resistance of airways, equivalentorifice, distribution of air, flow control devices.

UNIT - III

Natural Ventilation: Calculation of NVP from air density, artificial aids to natural ventilation. Mechanical ventilation: Principal types of mine fans and their suitability, merits, limitation, efficiency and characteristics. Selection of mine fan, fan testing, output control in fans, series and parallel operation of mine fans. Controlled recirculation, ventilation network analysis.

UNIT - IV

Auxiliary fan, duct, matching of fan to the duct system. Reversal of air current. Fan drift, evasee, diffuser, booster fans, Face Ventilation. Ventilation surveys and surveying instruments. Ventilation planning: Standard of ventilation including permissible air velocities. Ascensional, descensional, homotropal, anti- tropal ventilation. Central and boundary ventilation – ventilation surveys and surveying instruments, layouts and comparison. Economics of ventilation.

UNIT - V

Quantity and pressure requirement. Ventilation layout for coal mining and metal mining. Calculation of air quantity and total mine head required for ventilating a mine. Introduction to Network analysis: Hardy-Cross method, Ventilation survey.

TEXT BOOKS:

1. Mine Environment and Ventilation – G.B. Misra
2. Mine Ventilation and Air Condition – HL Hearlman

REFERENCE BOOKS:

1. Vatukuri V.S. & Lama R.D. – Environmental Engineering in Mines.
2. Dhar B.B. – Mining and Environment.

ROCK FRAGMENTATION ENGINEERING (BT MN406)

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

Course Outcomes:

CO 1. Although shotfirer supervisor the drilling and blasting operation statutorily any mines, students are expected to have detailed knowledge on rock fragmentation techniques.

CO 2. This course enables the student to have clear perception of rock fragmentation techniques and its field applications.

Course Outcomes (COs):

CO1	Although shotfirer supervisor the drilling and blasting operation statutorily any mines, students are expected to have detailed knowledge on rock fragmentation techniques.	K1
CO2	This course enables the student to have clear perception of rock fragmentation techniques and its field applications.	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		

CO Average	2.5		3	1		1			2.5	2		

UNIT- I

General theory of rock cutting, selection of cutting tools for optimum penetration and wear characteristics. Mechanics of rotary, percussive and rotary-percussive drilling, short and long hole drilling equipment, different types of bits, bit wear, drilling in difficult formations, drillibality of rocks, drilling performance and costs.

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

1. P. Pal Roy Rock Blasting effect and operation, A A Barkolna 2005
2. S. K. Das Explosive and Blasting Practices in Mines Lordy Prakashan, 1993

REFERENCE BOOKS:

1. B. H. Garg: Blasting Operation, McGraw Hill, 1981
2. CP Chugh, Drilling Technology Handbook, Oxford & IBH, 1977

MINING GEOLOGY LAB (BT MN407L)

Course Objectives:

The geological concepts, processes, materials and phenomena are well understandable in the field rather than in the class room. An attempt in this direction is to show some important minerals and rocks, models of geological structures, and maps of different kinds in the laboratory.

Course Outcomes: At the end of the course, students will be able to:

CO 1. Identify the properties of rock forming and ore forming minerals.

CO 2. Determine the strike and dip of planar features by Clinometer Compass.

CO 3. Identify the folds, faults and unconformities.

CO 4. Understand the importance and uses of topographic and geological maps in the miningprofession

CO 5. Understand the unconfined compressive strength of important rocks.

Course Outcomes (COs):

CO1	Identify the properties of rock forming and ore forming minerals.	K1
CO2	Determine the strike and dip of planar features by Clinometer Compass.	K2
CO3	Identify the folds, faults and unconformities.	K4
CO4	Understand the importance and uses of topographic and geological maps in the miningprofession	K3
CO5	Understand the unconfined compressive strength of important rocks.	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

List of Experiments:

1. Identification and systematic description of physical properties of important rock-forming andore-forming minerals (as mentioned in the theory syllabus) (2 Weeks)
2. Identification and systematic description of important igneous, sedimentary and metamorphicrocks (as mentioned in the theory syllabus) (3Weeks)
3. Determination of strike and dip of planar features using /Brunton Compass and the study ofmodels pertaining to folds, faults, unconformities and tunnels.
4. Study and interpretation of Topographic Maps.
5. Study of Geology and Mineral Resources of Telangana, Andhra Pradesh & India (GSIPublications)
6. Study of Metallogenic Map of India (GSI Publication)
7. Vertical Electrical Sounding Survey to determine depth to water table & bed rock.
8. Determination of unconfined compressive strength of rocks (Demonstration)
9. Field work/ visit to the nearby Quarries/Open Cast Mines and Underground Mines to learnGeologic Mapping

Lab Examination Pattern:

1. Identification and description of SIX Minerals.

2. Identification and description of SIX Rocks.
3. Measurement of Strike and Dip of an inclined planar feature (drawing board model) by aclinometer compass.
4. Identification and description of FOUR models pertaining to folds, faults, unconformities andtunnels.
5. Interpretation of a topographic map/ geological map of India/metallogenic map of India.

MINE SURVEYING – II LAB (BT MN408 L)

Course Objectives:

To familiarize with the various surveying instruments and methods

Course Outcomes: At the end of the course, students will be able to

CO 1. Conduct the correlation by two shaft co-planar method.

CO 2. Conduct the correlation by shaft weisbatch methods and shaft weiss quadrilateral methods.

CO 3. Set a curve by ranging offsets from long chord and ranging ranking method.

CO 4. Set a curve by Tacheometric and ranging tacheometric methods.

Course Outcomes (COs):

CO1	Conduct the correlation by two shaft co-planar method.	K1
CO2	Conduct the correlation by shaft weisbatch methods and shaft weiss quadrilateral methods.	K2
CO3	Set a curve by ranging offsets from long chord and ranging ranking method.	K4
CO4	Set a curve by Tacheometric and ranging tacheometric methods	K3

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		

CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

LIST OF EXPERIMENTS (Any 10 to 12 Experiments to be done minimum)

1. Determination of constants k and C by tachemometric surveying.
2. Tachemometric surveying by stadia method- distance and elevation formulae for staff vertical.
3. Tachemometric surveying by stadia method- distance and elevation formulae for staff normal.
4. Tachemometric surveying by tangential method- when both angles are angles of elevation.
5. Tachemometric surveying by tangential method when both angles are angle of depression.
6. Tachemometric surveying by tangential method when one angle is elevation and otherdepression.
7. Curve ranging by offsets/ordinates from the long chord.
8. Curve ranging by Rankine's method of tangential (or deflection) angle.
9. Correlation in single shaft by co-plantation method.
10. Correlation in single shaft by Weisbach triangle method.
11. Correlation in two shafts by weiss quadrilateral method
12. Finding the height of an in accessible object.
13. Reading mine plans and sections.
14. Using total station for measurement of volumes

Text Books/Reference Books:

1. Surveying- Vol. II by Punimia
2. Surveying and Levelling by kanetkar.
3. Mine Surveying and Levelling by Ghatak.

INTRODUCTION TO INDUSTRIAL ENGINEERING (BT MN501)

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcome:

CO 1. The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading,

CO 2. Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domainarea.

Course Outcomes (COs):

CO1	The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading,	K1
CO2	Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domainarea.	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT- I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT- II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving

- Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making,Creativity and Innovation in Managerial Work.

UNIT- III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures;Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization;Organizational Culture; Organizational Climate and Organizational Change.
Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT- IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.
Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency and Methods.

TEXT BOOKS:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

REFERENCE BOOKS:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

ENVIRONMENTAL MANAGEMENT IN MINES (BT MN502)

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

Course Outcomes:

CO 1. Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles.

CO 2. Environmental regulations which inturn helps in sustainable development

CO1	Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles.	K1
CO2	Environmental regulations which inturn helps in sustainable development	K2

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT- I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and

carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situconservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-waste and its management. Pollution control technologies: Waste water Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global Environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste

management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA),Low carbon life style. Procedure of obtaining environmental clearances for mining Projects.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha forUniversity Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHI LearningPrivate Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela .2008 PHILearning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

MINE ENVIRONMENTAL ENGINEERING – II (BT MN503)

Course Objectives: To introduce causes of mine fires, advances in more lighten technology, explosioncauses of, mine inundation etc.

Course Outcomes:

CO 1. Student can get through knowledge on various issues of mine environmental engineering including assessment and control of hazard due to mine fires, inundations, mine dust etc.

CO 2. Can be able to apply the concepts of hazard control measures in the real world mining problems in future.

Course Outcomes (COs):

CO1	Student can get through knowledge on various issues of mine environmental engineering including assessment and control of hazard due to mine fires, inundations, mine dust etc.	K1
CO2	Can be able to apply the concepts of hazard control measures in the real world mining problems in future	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT- I

Spontaneous Combustion: Various theories, factors, various indices for determination of susceptive of coal to spontaneous heating, control measures. Mine Fires: Survey of various causes of mine fires with statistical data of Indian mines, various methods adopted to combat fires and the its advantages and disadvantages.

UNIT- II

Advances in firefighting techniques and equipments, rescue operations in fire zones. Reopening of Selected off areas; Factors to be considered, methods, precautions. Reopening of sealed-off areas: Factors to be considered, methods, precautions. Mine Explosions: Causes of firedamp explosion with statistical data of Indian mines, preventive measures against firedamp explosion.

UNIT- III

Production, assessment and control of mine dust and associated hazards. Causes of coal dust explosion with statistical data of Indian mines, preventive measures against coal dust

explosion. Designof stone dust barriers.

UNIT- IV

Mine Inundation: Causes of inundation with statistical data of Indian mines. Precaution to be taken while approaching old workings, safety boring machines preventive measures of inundation. Design of waterdams, recording of flooded mines, layout of drainage systems and sumps, Noise and Vibrations: Causes and measurement of noise levels. Precautions, prevention and reduction of noise levels. Environmental aspects of blast induced vibration and noise.

UNIT- V

Mine illumination: Its effects on safety and efficiency, illumination standard, electric-hand and cap lamp, their maintenance and examination, lamp room design and organization. Illumination arrangement of opencast and underground working. Illumination surveys. Rescue and recovery work, equipment, short distance apparatus. Self-contained oxygen-breathing apparatus. Rescue stations, principles of risk management. First aid in mines and statutory requirements. Rescue and recovery operations in minesincluding through bore holes.

TEXT BOOK:

1. Mine Environment & Ventilation – G.B. Misra.

REFERENCE BOOKS:

1. Mine Fires, Explosion, Rescue, Recovery and Inundation – M.A. Ramulu.
2. Fires in Coal Mines – Kaku

MINE MECHANIZATION – II (BT MN504)

Course Objectives: This is the second paper in the mine mechanization course. In the previous papera few machinery working in the mining industry were introduced to the student. In this paper some moremachines like winders in deep mines, opencast mine machinery and mine pumps are introduced.

Course Outcomes:

CO 1. After going through this course the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz.

CO 2. Different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc.

Course Outcomes (COs):

CO1	After going through this course the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz.	K1
CO2	Different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT- I

Mine Winders: Koepe and Drum winders and their applications, head gear and its design, head gear pulley, shaft fitting – Keps, rope guides, shaft sinking and bells, capping and recapping and its design, cage and suspension gear. Pit top and pit bottom lay outs. Pit top railway sidings.

UNIT- II

Winding Drum-types and construction, Safety devices in winders-over speed and over wind

preventers, slow braking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft. Numerical problems in different types of winding including Torque – time diagrams.

UNIT- III

Man riding system in underground mines. Face Machinery: SDL, LHD, Shuttle cars, underground trucks different types of mechanical loaders – their constructions, operation, applications, capacity and maintenance. Cutter loaders – Shearers, Coal plough and Continuous Miners – their constructional features, applications, capacity and maintenance; Hydraulic power pack. Maintenance of equipment including preventive maintenance and condition monitoring. Hydraulic layouts of longwall focus. Introduction to automation: construction and operation of coal drill and Iachhammer.

UNIT- IV

Power loader (Mechanical loader), Shuttle cars: their constructions, operation, applications, capacity and maintenance. Pumps: Sources of water in mines, design of sumps, types, Construction, operation, characteristics and application, Calculation of size, efficiencies and capacities. Layout of drainage system.

UNIT - V

Opencast Machinery: Blast Hole Drill, Ripper, front and loaders, dozers, road grades, Shovel, rock breakers, water tankers, Dragline, Dumper, including machinery and tracker –etc., Bucket Wheel Excavator, Continuous Miners drayars – their basic construction, applications and operation. Mine Electrical Engineering: Distribution of electrical power in mines, types of mine cables and their fields of application, flame proof and intrincially safe equipment/circuits, signaling and telecommunication in mines including fiber optic cables and walking talkies and mining switch years. Electrical layout of longwall focus.

TEXT BOOKS:

1. Deshmukh D.J., Vol. I & II Elements of Mining Technology.
2. Cherkasky B.M., Pumps & Compressors
3. Walkar winding & Transport

REFERENCE BOOKS:

1. Alemgren, G. Kumar – Mine Mechanisation and Automation.
2. Mason – Coal Mining Series.

SURFACE MINING TECHNOLOGY (BT MN505)

Course Objectives: The students will have ability to classify and select the suitable surface mining methods and equipment based on site conditions. They will also have a concept of waste dump formations and slope failures in surface mines.

Course Outcome:

CO 1. The outcome of this course is to provide students in mining engineering with the necessaryknowledge to design safe, efficient and environmentally responsible surface mining operations.

CO 2. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars relatedto this course.

Course Outcomes (COs):

CO1	After going through this course the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz.	K1
CO2	Different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO	2.5		3	1		1			2.5	2		

Average												

UNIT - I

INTRODUCTION: Status of surface mining, types of surface mines, applicability and limitations, concept of stripping ratio, stripping economics, concept of ultimate pit limits, design of haul roads, elements of surface mine planning - selection of site for box cut, selection of operating parameters like bench height, width, slope, etc.

UNIT - II

LAYOUT AND DESIGN OF SURFACE MINES: Slopes in surface mines – Highwall and waste dumps; Working pit slope and ultimate pit slope, common modes of slope failures, factors influencing stability of slopes, Development of opencast mine layouts for various shapes of deposits. Conversion of Underground mine to opencast mine vis-a vis open cast mine to underground mine related problems and probable solutions.

UNIT - III

GROUND PREPARATION METHODS: Preparation of the site – Ripping, Drilling and Blasting; Types, operation, selection, applications and limitations of ground preparation equipments – Rippers, Dozers, Blasthole drills and rock breakers, Determining number of drill machines, dozers and rippers for planned production. Concept of rippability, Blasting in Opencast Mines over Developed Galleries. Introduction to Placer and Sea bed mining, hydraulicking, dredging ground slicing. Exploitation systems of sea bedmineral resources.

UNIT - IV

EXCAVATION SYSTEM IN SURFACE MINES: Selection criteria for excavation / loading and material transport equipment used in surface mines. Classification, application and limitations of different types of excavating / loading equipment used in surface mining projects; Cycle time and productivity calculation for excavating & loading equipments; Dragline - calculation of required bucket capacity for a given handling requirement, Method and cycle of operations of Draglines, Front end loaders, Scrapers, Bucket wheel and bucket chain excavators, Surface miners. Introduction to dredgers of different types. Determining the capacity and number of shovels and dumpers for planned production.

UNIT - V

TRANSPORT AND WASTE DUMPS: Scope and application of different modes of transport system in surface mines – Trucks, Synchronization of shovel and dumper capacity for required production; Locomotives; Conveyors (shiftable and high-angle) – mode of operation, applicability and limitations, Scope and application of in-pit crushers in surface mines. Illumination in surface mines**.** Types of waste dump – internal and external; dump formation methods and corresponding equipment; Dump stability and stabilisation measures.

TEXT BOOKS:

1. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
2. Hartman H.L., Introductory Mining Engineering, John Wiley and Sons, 2002.

REFERENCE BOOKS:

1. Hartman, H.L. (Ed.), SME Mining Engg. Handbook Vol. I and II, Society for Mining,Metallurgy, and Exploration, Inc., 3rd edition, 2011.
2. Mishra G.B., Surface Mining, Dhanbad Publishers, Dhanbad, 1990.
3. Pfleider, E. P, Surface Mining, 1st Edition, New York, 1968.
4. Rzhevsky V., Open pit Mining Operations, Mir Publications, 1971.

INTELLECTUAL PROPERTY RIGHTS (BT MN506)

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter,selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right

registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT & REFERENCE BOOKS:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, TataMcGraw Hill Publishing company ltd.

MINERAL PROCESSING ENGINEERING LAB (BT MN507L)

Course Objectives: To study various mineral processing techniques to enrich minerals

Course Outcomes: At the end of the course, students will be able to

CO 1. Know different sample division techniques.

CO 2. Determine the grinding and crushing characteristics of a given mineral sample.

CO 3. Know the washability characteristic of a coal sample.

CO 4. Determine the moisture content by drying of mineral sample.

CO 5. Determine the average size of samples.

Course Outcomes (COs):

CO1	Know different sample division techniques.	K1

CO2	Determine the grinding and crushing characteristics of a given mineral sample.	K2
CO3	Know the washability characteristic of a coal sample.	K4
CO4	Determine the moisture content by drying of mineral sample.	
CO5	Determine the average size of samples	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO5						1						
CO Average	2.66	2	3			1			2	1.66		

LIST OF EXPERIMENTS:

1. Study of grab sampling and different sample division techniques like coning and quartering, rifflesampling techniques, etc.
2. Determination of crushing characteristics of a given mineral sample using jaw crusher
3. Determination of the grinding characteristics of a given mineral sample un=sing ball mill.
4. Sieve analysis of a given sample and to calculate (a) percentage sample retained on screens

   (b) average size of ample material and (c) to plot sizing curves
5. Concentration of a given mineral using Wilfley table
6. Concentration of a given mineral using froth flotation cell
7. concentration of a given mineral using magnetic separator
8. Study of washability characteristic of coal samples using sink-float tests.

9. Study of sedimentation characteristics of a given sample

MINE MECHANIZATION LAB (BT MN508L)

Course Objectives: To impart knowledge to students about:

1. Construction as operations of various types of engineer, mining equipment etc.
2. Testing procedure for determination of various properties of mining machinery like efficiency,strength friction etc.

Course Outcomes: The students will be able to

CO 1. Describe the constructional details of various mining equipment.

CO 2. Explain the working of mining machinery.

CO 3. Evaluate the properties of mining machinery

Course Outcomes (COs):

CO1	After going through this course the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz.	K1
CO2	Different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc	K2
CO3	Evaluate the properties of mining machinery	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3												
CO	2.5		3	1		1			2.5	2		

Average												

LIST OF EXPERIMENTS (Any 10 to 12 Experiments to be done minimum)

1. To find out the angle of friction for different materials.
2. Coefficient of friction between belt / rope and pulley
3. Determination of Efficiency of a screw jack
4. Study of construction and operation of 4stroke SI engine model.
5. Study of construction an d operation of 4 stroke CI engine model.
6. Performance testing of a 4 stroke Diesel engine.
7. Performance test of reciprocating air compressor
8. Study of different types of gear and gear trains.
9. To study the construction of multi-speed gearbox used in dozer.
10. Study of rope brake dynamometer.
11. Study of different types of couplings.
12. Study of multiple clutches
13. To study the jump phenomena of Cam and Follower
14. Study of gate end box
15. Study of drill panel and hand held electrical in a drill
16. Study of mining type electric cable.
17. Study of pillar switch
18. To develop different hydraulic circuits in hydraulic trainer.
19. To study the construction and operation of hydraulic pumps, motors and valves
20. To study the construction and operation of hydraulic fittings and hoses.
21. Performance investigation of hydrostatic transmission systems with different motors.
22. To develop different pneumatic logic circuits in pneumatic trainer
23. Performance test of centrifugal pumps
24. Performance test on reciprocating pump
25. Dismantling and assembly of Jack Hammer Drill machines
26. Determination of fatigue strength of steel wires
27. Determination of Breaking strength of steel wire ropes

TUNNELING ENGINEERING (BT MN601)

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

Course Outcomes:

CO 1. Students can understand various methods of tunneling use of latest numerical techniques for tunnel design,.

CO 2. Stability analysis, and ground control measures with various steel support and rock reinforcement

Course Outcomes (COs):

CO1	After going through this course the student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz.	K1
CO2	Different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc	K2

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO Average	2.5		3	1		1			2.5	2		

UNIT- I

Introduction to tunneling; geological parameters to be considered for tunneling.

Influence of geological aspects on design & construction of tunnels.

Types of underground excavations.

UNIT- II

Different methods of tunneling; Conventional and special drill & blast roadway drivage methods, TunnelBoring Machine (TBM);

UNIT- III

Stresses and displacements associated with excavating tunnels, Ground control or treatment in tunneling and drivages. Design of Supports of Tunnels; Steel supports, rock enforcements, new Australian tunneling methods (NATM)

UNIT- IV

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

UNIT - V

Tunneling in soft ground; Excavation of large tunnels; hazards in tunneling. Ground treatment in excavation.; application of road headers and drill jumbos in tunneling: principle of operation, applicability, advantages and limitations. Applications of numerical techniques and relevant software'sin tunneling (in brief).

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MINERAL PROCESSING (BT MN602)

Course Objectives: The prime objective of this course is to build the solid foundation on principals and equipment of various mineral beneficiations procedures that would facilitate metal extraction. It also focuses on mathematical derivations that are associated with

concentration processes.

Course Outcomes: At the end of the course the student will be able to:

CO 1. Understand the importance of mineral processing technology.

CO 2. Understand techniques of mineral processing for concentration of ore minerals economically.

CO 3. Review environment friendly techniques for concentration of sulphide minerals.

CO 4. Compute the recovery of ore mineral after concentration.

Course Outcomes (COs):

CO1	Understand the importance of mineral processing technology.	K1
CO2	Understand techniques of mineral processing for concentration of ore minerals economically.	K2
CO3	Review environment friendly techniques for concentration of sulphide minerals.	K4
CO4	Compute the recovery of ore mineral after concentration	

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

MINERAL PROCESSING (BT MN602)

UNIT - I

Scope and Objectives of Ore Dressing: Sampling of ores by different methods; Theory of

liberation of minerals; Crushers - Jaw, Gyratory, Cone, Rolls and Toothed Roll crushers; Grinding - Types of grinding operations like Batch and Continuous grinding, Dry and Wet grinding, Open circuit and Closed-circuit grinding, Grinding Mills - Ball mills, Theory of ball mill operation, Rod and Tube mills; Comminution laws
- Rittinger's laws, Kick's law and Bond's law.

UNIT - II

Sizing: Study of laboratory sizing techniques and reporting of sizing data; Industrial sizing units - Types of screen surfaces, Grizzlies, Trommels, Vibrating and Shaking screens; Movement of solids in fluids –Stokes' and Newton's laws, Terminal velocity and its relation with size, Relation between time and velocity, Relation between distance travelled and velocity; Equal settling ratio, Free and hindered settling ratios; Quantifying concentrating operations - Ratio of concentration, Recovery, Selectivity Index and Economic Recovery; Classification – Types of classifiers, Study of Settling Cones, Rake Classifier, Spiral Classifier and Cyclones.

UNIT - III

Heavy Media Separation - Principles, flow chart, different media used, Heavy Media Separation using heavy liquids and heavy suspensions, Washability curves for easy, normal and difficult coal; Magneticseparation processes and Electrostatic separation process.

UNIT - IV

Jigging: - Theory of jigging, jigging machines - Harz jig, Denver jig Baum jig, Hancock jig, James coal jig and Halkyln jig, Design considerations in a jig. Tabling - Study of stratification on a table. Shaking tables, Wilfley table.

UNIT - V

Flotation - Principles of flotation, Factors affecting flotation, Classification of Collectors and Frothers, Regulators, and Factors affecting their efficiency, Application of flotation process for Cu, Pb and Zn ores.

TEXT BOOKS:

1. Mineral processing technology - B. A. Wills

2. Principles of Mineral Dressing - A.M. Gaudin
3. Introduction to Mineral Processing by V. Malleswara Rao, Indian Academy of Geoscience

REFERENCE BOOKS:

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

INTRODUCTION TO INSTRUMENTATION (BT MN603)

Course Objectives: To have a knowledge of

- Electronic Instruments
- Pressure measurements
- Flow measurements
- Vibration, Viscosity and Humidity Level measurement
- Various analysers

Course Outcomes: The knowledge gained on electronic, pressure, flow and vibration measurement will provide a strong platform to understand the concepts on these subjects for further learning**.**

CO1. Describe the basic concepts and significance of instrumentation systems used in engineering and industrial applications.

CO2. Explain the principle and working of common measuring instruments used for temperature, pressure, level, flow, and displacement.

CO3. Interpret measurement data and calibrate instruments to ensure accuracy and reliability of results.

CO4. Apply knowledge of instrumentation systems to solve basic industrial control and automation problems.

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Describe the basic concepts and significance of instrumentation systems	K2, K3

	used in engineering and industrial applications.	
CO2	Explain the principle and working of common measuring instruments used for temperature, pressure, level, flow, and displacement.	K4
CO3	Interpret measurement data and calibrate instruments to ensure accuracy and reliability of results.	K4
CO4	Apply knowledge of instrumentation systems to solve basic industrial control and automation problems.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT I

ELECTRONIC INSTRUMENTS:CRO - Storage oscilloscope – Digital voltage meter (DVM) – Digital multi meter – XY recorder, Strip chart recorder – Digital recording- Data logger – Introduction to virtualinstrumentation.

UNIT II

PRESSURE MEASUREMENTS: Unit of Pressure – Manometers- Different types, - Elastic typepressure gauges – Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and

strain gauge

– Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivitygauge – Ionisation gauge.

UNIT III

FLOW MEASUREMENTS: Flow meters – Variable head type flow meter – Orifice plate – Venture tube

– Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flowmeter – Rota meter – Mass flow meters.

UNIT IV

VIBRATION, VISCOSITY, HUMIDITY, LEVEL MEASUREMENT: Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer - Vibrometers – Viscosity – Saybolt viscometer. Humidity – Hot wire electro type hygro meter - Dew cell – Electrolysis type hygrometer.

UNIT V

ANALYSERS: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium analyser – Silica analyser – Turbidity meter – Gas analyser – NOx analyser – H2S analyser –CO and CO2 monitor, Dust & Smoke measurement.

TEXT BOOKS:

1. Alan S. Morrris. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt.,Ltd. New Delhi, 1999
2. Ernest O Doeblin. Measurement Systems Application & Design, Tata McGraw HillPublishing Co., New. Delhi, 1999

REFERENCE BOOKS:

1. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd.New Delhi.
2. Patranabis, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
3. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi,

1999.

4. Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994

UNDERGROUND COAL MINING TECHNOLOGY (BT MN604)

Course Objectives:

- To study the development of panels and extraction of coal in Bord and Pillar method
- To study the Long wall advancing and retreating methods
- To study the various special methods of winning coal
- To study and update of the mine criteria as per various legislation of India.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars relatedto this course.

Course Outcomes: The students will gain knowledge on development and depillaring of coal by Bordand Pillar and advancing and retreating in Longwall methods. They will also know about methods of winning of coal seams which have special features.

UNIT -I

INTRODUCTION: Status of coal industry and deposit, factors affecting choice of mining methods, classification of mining methods, grading and analysis of coal.

UNIT -II

BORD AND PILLAR METHOD-DEVELOPMENT: Design and development of a district / panel, sizes and shapes of galleries and pillars, bord and pillar, room and pillar methods, with conventional and continuous mining techniques with various equipment.

UNIT -III

BORD AND PILLAR METHOD – EXTRACTION: Pillar extraction by caving and stowing methods; mechanised extraction of pillars, shaft pillar extraction, systematic supports, surface, underground andface arrangements for stowing. Partial extraction.

UNIT -IV

LONGWALL METHOD: Advance and retreat methods, continuous and cyclic systems, extraction with different machines-ploughs, shearers, design of longwall workings, optimum length of face, size of panel, gates, support system, personnel, organisation and safety measures, salvaging and relocations of equipment, Punch longwall.

UNIT -V

SPECIAL METHODS OF WORKING: Problems of working thick & thin seams, multi slices, sublevel caving, horizon mining, gallery blasting method, contiguous seam working, working steeply inclined seams, working under surface structures and seams liable to spontaneous heating, outburst and bumps, etc. hydraulic mining, Wongawalli, shortwall, highwall mining, underground coal gasification, coal bed methane, shield mining.

TEXT BOOKS:

1. Singh, R.D. Principles and Practices of Modern Coal Mining, New Age International (P) Ltd.,Chennai, 1994.
2. Peng S.S., and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992.

REFERENCE BOOKS:

1. Singh, T.N. Singh, Underground Winning of Coal – Oxford & IBH Publishing Co. Ltd., 1992.
2. Mathur, S.P., Coal Mining in India, M.S. Enterprises, Bilaspur, 1999.
3. Mathur, S.P., Mining Planning for Coal., M.G. Consultants, Bilaspur, 1993.
4. Szwilski and Richards M.J., Underground Mining Methods and Technology, 1987.

ROCK MECHANICS ENGINEERING (BT MN605)

Course Objectives:

CO 1. To study and understand various aspects of rock mechanics and its application to mining.

CO 2. Introducing the various instrumentation and measurement methods.

CO 3. To study the theories of failure and approaches used for open pit and underground designs.

CO 4. To understand various aspects of supports and their design for various situations.

CO 5. To know the various statutory aspects like CMR, MMR and the relevant DGMS

circulars relatedto this course.

Course Outcomes: The students will have knowledge on rock mechanics instrumentation, approach to pit slope stability, theories of subsidence and failure of rocks. They will also know about design of underground openings and methods of stowing.

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT -I

Physical and Mechanical Properties of Rocks: Definition of some important terms used in rock mechanics, application of rock mechanics in mining, Physical properties of rocks-density, porosity, moisture content, permeability, water absorption various indices of rocks like hardness, Protodynakov index, slake durability index, impact strength index, etc, Preparation of test specimens, laboratory determination of mechanical properties of rocks-compressive strength, tensile strength, flexural strength, shear and triaxial strength, modulus of elasticity, Poisson's ratio. Dynamic wave velocities, dynamic elastic constants, their determination in the laboratory, application in mining, time dependent properties of rocks, creep, mechanism of creep of rocks-different stages, rheological models.

UNIT -II

Supports and Supporting: Various methods of roof examination, objectivesand limitations of supports, ground forces and in situ stresses, pressure arch theory, evolution of supports,

conventional supports- timber and steel supports, arches, yielding supports; rock and cable bolting, shotcreting, roof stitching,support of shaft bottoms, galleries, junctions and places of roof falls, freshly exposed roof supports, longwall powered supports. Design of systematic support rules for B & P and longwall (face and roadways) - development, depillaring, etc.

UNIT -III

Rock Mechanics Instrumentation, Pit Slope Stability: Convergence indicators, load cells, strain gauges, flat jacks, LVDT, dial gauges, pressure cells and recorder, anchorage testing equipment, laboratory and in situ measurements, hydraulic fracturing rock mechanics, strata instrumentation for B & P and longwall workings, Approach to slope stability, slope parameters, different types of slope failures, factors affecting slope stability, introduction to methods of failure, analysis, determination of factor of safety,. Introduction to different rock slope stabilisation techniques,

UNIT -IV

Subsidence and Stowing: Theories of subsidence, factors affecting subsidence, subsidence surveys, subsidence prediction techniques, subsidence control – surface and underground measures, pseudo-mining damage. Selection and preparation of stowing materials, principal methods of stowing, collection, fields of application and limitations, surface, underground and face arrangements, design of stowing plants.

UNIT V

Theories of Failure, Pillar Design, Design of Underground Workings and Rock Burst: Different theories of failure of rocks, modes of failure - Griffith, Coulumb-Navier, Mohr, Hoek-Brown, empirical criteria, etc. and their field of applications, Strength of pillars, barrier and shaft pillar design – roof load estimation, factor of safety, various formulae, rock burst and bumps - phenomena, causes, prediction, monitoring and control, gas outbursts, stress distribution in underground workings including bord andpillar and longwall workings.

TEXT BOOKS:

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley andSons Inc., New York, 1967.
2. Vutukuri, V.S. and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol.I,

II, III andIV, Transtech Publication Berlin, 1974/78.

3. Peng S.S., and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992.

REFERENCE BOOKS:

1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
2. Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy,London, 1980.
3. Jumkis, A.R. Rock Mechanics, Transtech Publications, Berlin, 1983.

ENVIRONMENTAL SCIENCE (BT MN606)

Course Objectives:

CO 1. Understanding the importance of ecological balance for sustainable development.

CO 2. Understanding the impacts of developmental activities and mitigation measures

CO 3. Understanding the environmental policies and regulations

Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development.

CO 1. Understand the structure and function of natural ecosystems and their importance in environmental balance.

CO 2. Identify the causes and impacts of environmental pollution (air, water, soil, and noise) and suggest sustainable mitigation strategies.

CO 3. Evaluate the role of renewable and non-renewable resources and the need for sustainable development.

CO 4. Interpret environmental policies, laws, and acts for environmental protection at national and global levels.

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		

CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function ofan ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity.Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situconservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of

modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP).

Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA),Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha forUniversity Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL LearningPrivate Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHILearning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.

4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

GROUND CONTROL & INSTRUMENTATION LAB AND COMPUTER APPLICATIONSIN MINING LAB (BT MN607L)

Course Objective: To study the computer programming for mining problems, mine ventilation network analysis, modeling of surface and underground workings using various software.

Course Outcome: The students will able use the planning software for surface and undergroundmining methods.

LIST OF EXPERIMENTS:

1. Design of pillars
2. Blast design
3. Subsidence prediction.
4. Mine ventilation network analysis.
5. Modelling of airflow through underground workings using CFD.
6. Ore body modeling.
7. Slope stability analysis in soil and rocks.
8. Fragmentation Analysis
9. Truck dispatch system optimization
10. Digital Terrain and Wire-frame modelling
11. Surface Mine Design using MPD Software
12. Underground Mine Design using MPD Software
13. Pit optimization using MPD Software
14. Production Scheduling for grade control
15. Design of experiments.

LIST OF EXPERIMENTS:

1. Studies on CONVERGENCE METER for monitoring convergence in mines
2. Studies on BOREHOLE STRESS CELL for monitoring stress in underground workings.
3. Studies on VIBRATING WIRE TYPE LOADCELL for monitoring load on supports.
4. Studies on LAYOUT OF INSTRUMENTS for monitoring ground behavior around Longwall
5. Studies on LAYOUT OF INSTRUMENTS for strata behavior monitoring in thick seams.
6. Studies on LAYOUT OF INSTRUMENTS for monitoring ground behaviour in metal mines.
7. Studies on LAYOUT OF INSTRUMENTS for slope monitoring in opencast mines.
8. Studies on REMOTE CONVERGENCE INDICATORS for roof fall monitoring in mines.
9. Studies on BOREHOLE EXTENSOMETER for monitoring bed separation in mines.
10. Studies on VIBROGRAPH for monitoring ground vibrations due to blasting.

REFERENCE BOOKS:

1. E Balagurusamy, Fundamentals of Computers, Mc Graw Hills Publication, 2009
2. MPD Software Manual.
3. Fragalyst Software Manual

ROCK MECHANICS ENGINEERING LAB (BT MN608L)

Course Objectives:

- To study the various of methods to determine the properties of rocks.
- To study the operation of various instruments and equipment.

Course Outcomes: The students will have knowledge on strength and deformation characteristics ofrock using different methods.

List of Experiments (Any 10 to 12 Experiments to be done minimum)

1. Determination of RQD of rocks.
2. Determination of Protodyaknov index of a given rock sample
3. Determination of point load index strength of a given rock sample
4. Determination of porosity of rocks.

5. Determination of uniaxial compressive strength of a given rock sample
6. Determination of tensile strength of a given rock sample using Brazilian method
7. Determination of shear strength of rocks
8. Determination of modulus of elasticity of given rock sample using strain gauge.
9. Determination of triaxial strength of rock and drawing of Mohr's envelope
10. Determination of slake durability of rocks
11. Study of drillability index of rocks.
12. Study of different types of roof convergence and other ground control instruments.
13. Determination of time dependent deformation of rocks.
14. Determination anchoring capacity of rock bath
15. Blast induced ground vibration and air-ore pressure determination
16. Determination of percentages shrinkages of different blowing materials
17. Determination of in-situ stress by flatjack
18. Determination of port failure behavior of rocks.

ADVANCED SURFACE MINING (BT MN701)

Course Objectives:

- To introduce the various techniques for mine planning, geotechnical investigation andequipment management.
- To appreciate the modern trends in opencast mines, safety and environment

Course Outcomes: The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends inopencast mines, safety and environment.

UNIT - I

Pit Planning: Development of economic block model; Pit cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method. Addition of haulroad on pit plan; Pit layouts. Open- pit optimisation techniques for mine geometry and output, mine development phases, quality control Output and manpower planning; calendar planning,

mine scheduling, production scheduling, truck dispatch system; Feasibility Report, DPR-contents and preparation.

UNIT - II

Geotechnical Parameters: Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; stability analysis and design methodology for waste dumps; Application of geotechnical investigation for design of ultimate pit slope and other design parameters. Numerical problems on slope stability analysis including mine waste rock dumps and tailing dumps.

UNIT - III

Production and Equipment Planning: Determination of mine size and sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing; Production scheduling. Stockpiling and blending, Spreaders and Reclaimers; computerized truck dispatch. Selection of mining system vis-à-vis equipment system; Computations for the capacity and number of machines vis-à-vis mine production. Machine availability, productivity, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT - IV

Health, Safety and Environmental Management: Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Impact of surface subsidence; Accidents in Surface mining and their prevention; Sources of water, assessment of drainage requirements, sump design and drainage patterns - pumping systems. Pre-drainage through diversion channels and boreholes; Water pollution, Methods of reclamation of mined out areas, dumps and tailing ponds, environmental audit. Socio-economic factors in surface mines.

UNIT V

Modern Trends in Opencast Mines: Recent developments in mining methods and layouts. In pit crushing & conveying, continuous surface mining. Selective extraction and dumping. Extraction of seams developed/extracted by underground methods. Deep Open pit Mining; Placer mining and solution mining – scope of applicability, sequence of development and machinery; Closure of surfacemines.

TEXT BOOKS

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society ofMining Engineers, New York, 2011.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open Pit Mine Planning & Design,Elsevier, 1995

REFERENCE BOOKS:

1 Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995

2 Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994

3 Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994

4 Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990

RISK ASSESSMENT AND MANAGEMENT (BT MN702)

Course Objectives: Upon completion of the course, the students shall be able to know the components of safety risk assessment, Epidemiological studies along with safety audit and management in mines

Course Outcomes: To understand the terminology and reason for preventing accidents, components of Risk Assessment. Apply the Safety Policies, Safety Audit and Safety Management in Mines along with Case studies.

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Understand the fundamentals of risk, hazard, and uncertainty in industrial and mining environments.	K2, K3
CO2	Identify various types of workplace hazards (physical, chemical, mechanical, biological, and ergonomic).	K4
CO3	Apply standard methods of risk assessment such as HAZOP, FMEA, fault tree, and event tree analysis.	K4
CO4	Develop and implement risk control measures to mitigate potential workplace incidents and accidents.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT- I

Introduction to Accident Prevention and Health & Safety in Industry: Terminology, Reason for preventingaccidents – moral, cost, legal.

UNIT- II

Accident statistics and trends in mining industry; Safety Risk in Opencast and Underground Mines; Risk Assessment: Concepts, Qualitative and Quantitative Approaches;

UNIT- III

Components of Risk Assessment: Risk Identification, Risk Estimation and Evaluation; Risk Analysis using FTA, HAZOP, ETA etc.; Risk Analysis Softwares; Health Risk Assessment and

UNIT- IV

Epidemiological Studies; Statistical and Economic Analysis of Accident Data; Risk Minimization Techniques in Mines; Generic approach to loss control within mining operations; Safety Policies, SafetyAudit and Safety Management in Mines.

UNIT- V

Application of Virtual Reality for Safety, Training and Marketing; Case studies on Safety Risk Assessment in Mining and allied industries

TEXT BOOKS:

1. B. K. Kejriwal, Safety in Mines, Lovely Prakashan, Dhanbad, 2002.
2. N. J. Bahr, System Safety Engineering and Risk Assessment: A Practical Approach, Taylor andFrancis, NY, 1997.

REFERENCE BOOKS:

1 Bhattacharya, *Accident Prevention and Safety Management in Mines,* Short Term Course, Nov.30-3rd Dec., 2004, IIT, Kharagpur, 2004.

2 Clifton, Ericson II, *Hazard Analysis Techniques for System Safety,* John Wiley & sons, NewJersey, Canada, 2005.

MINE SYSTEMS ENGINEERING (BT MN703)

Course Objectives: To make students familiar with scientific/Mathematical methods that areapplicable to mining industry for optimizing objectives.

Course Outcomes: The student should be able to identify some technical/ economic issues where mathematical methods can be applied to find solutions

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Understand the principles of systems engineering and their application in mining operations and project planning.	K2, K3
CO2	Analyze mine operations as interconnected systems**,** including production, maintenance, logistics, and safety.	K4
CO3	Apply techniques of operations research such as linear programming, network analysis, and simulation to optimize mining systems.	K4
CO4	Design and evaluate mine layouts and production systems for efficient resource utilization.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT- I

Development –Definition-Characteristics and Phases-Types of models-Operations Research models – applications. Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT- II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problem – Formulation – Optimal solution - Variants of

Assignment Problem-Traveling Salesman problem.

UNIT- III

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

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

UNIT- IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method. Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT- V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population. CPM and PERT Introduction to and importance of CPM. Determination of Early start time, Latest start time, Total float, Independent float, critical path, project duration. Crashing of networks Introduction to PERT, importance of PERT, expected time of completion of a project, probability of completion Application of CPM and PERT in mining industry. Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOKS:

1. Operations Research /J. K. Sharma 4e. /MacMilan
2. Operations Research/Er. Prem Kumar Gupta & Dr. D. S. Gupta/S. Chand

REFERENCE BOOKS:

1. Operations Research/S. R. Yadav & A. K. /Oxford

2. Operations Research/ ACS Kumar

UNDERGROUND METAL MINING TECHNOLOGY (BT MN704)

Course Objectives:

CO 1. To introduce concepts of metal mining and metal mining terminology.

CO 2. To study development and operations of metal mines.

CO 3. To study about special methods of metal mining methods.

CO 4. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars relatedto this course.

Course Outcomes: The students will have basic concept on metal mining methods, mine design, development and operations of metal mines. They will also know about novel methods of metal miningand its applications.

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Explain the different underground mining methods used for metal ore extraction based on ore body characteristics.	K2, K3
CO2	Compare the suitability, advantages, and limitations of methods such as cut and fill, room and pillar, sublevel stoping, and block caving.	K4
CO3	Select appropriate development and stoping methods based on geology, ore body geometry, and ground conditions.	K4
CO4	Describe the operation and application of equipment and machinery used in underground metal mining.	K3, K5

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		

CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Basics: Metal Mining Terminology; Typical modern metal mine features; exploration, estimation of block wise and mine wise reserves and actual production, typical pre-stoping ore block constructional features; classification of mining/ stoping methods.

UNIT - II

General Mine Design: Mode of mine and stope entry; Layouts; Determination of optimum production level; sequence of extraction, production scheduling; Basic design – Level Intervals, ore pass, commonore pass, size of blocks ore handling in stope and other openings, overview of constructional features
– X cuts, Raises, Winzes etc.

UNIT - III

Stoping – General Concepts: Techno-economic characteristics impacting choice of method; typical unit cost parameters; optimum size of a mine and stope. stope layout, design, equipment selection; preparing a stoping block; sequence of stoping; organization; production cycle; unit cost calculation; comparison of methods and costs

UNIT - IV

Stoping Methods: Unsupported methods – Stope and pillar, room and pillar, shrinkage, sublevel stoping etc. supported stoping– cut and fill, stull, square set, rill, etc. caving methods – Top slicing, sublevel caving, block caving. Case studies of Indian and foreign underground metal mines. Comparison of various methods of stoping and costs.

UNIT - V

Novel & Innovative Techniques and Special Applications: Hydraulic mining, slurry mining,

solution mining, nuclear mining; Rapid excavation; Radial – axial splitter; Thermal fragmentation; shock wave breaking; Deep mining; narrow contiguous veins; shaft and remnant pillars; VCR; Ring drilling; Large Blast hole stoping.

TEXT BOOKS:

1. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Hustrulid, W.A. Ed., Underground Mining Methods Handbook Society of Mining EngineeringAMIE, New York, 1990.

REFERENCE BOOKS:

1. BICCARD J C, Gold mining in Witwatersrand, The Transvaal chamber of mines, Volume I, II,1946
2. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society ofMining Engineers, New York, 2011

MINE LEGISLATION (BT MN705)

Course Objectives: Introduces mining laws and legislation to the students with basic knowledge on mining engineering aspects. The students will be explained about the provisions of Indian electricity rules, vocational training rules, The Mines rescue rules, The Mines and Minerals (Development and Regulation) Act etc.

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

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Understand the need and importance of mine legislation in ensuring safety, health, and welfare of mine workers.	K2, K3

CO2	Explain the key provisions of important mining laws and acts such as the Mines Act, 1952; Mineral Concession Rules; and MMR, 1961.	K4
CO3	Interpret roles and responsibilities of statutory personnel under mining laws.	K4
CO4	Apply legal provisions related to working hours, leave with wages, health and safety, and accident reporting in mines.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT- I

Introduction to mining laws and legislation, General principles of mining laws, development of mining legislation in India. The Mines Act, 1952, Bye-laws, Circulars, and standing orders (in brief).

UNIT- II

The Mines Rules, 1955; The Mines Vocational Training Rules, 1966; The Mines Rescue Rules, 1985. The Mines Crèche rules,1966; The Mines Maternity benefit Act, 1961; Payment of Wages Act, 2005; The Employee's (Workmen’s) Compensation Act, 2010; NCWB agreement (in brief).

UNIT- III

Coal Mines Regulations, 1957; Metalliferous Mines Regulations, 1961, and the associated technical circulars.

UNIT- IV

Indian Electricity Rules, 1956; General provisions of Mines and Minerals (Regulation and Development)Act 1957; The Mineral Concession Rules, 1960; The Mineral Conservation and Development Rules, 1988.

UNIT - V

General cases of accidents in mines and their prevention. Classification of accidents, accident enquiryreports, cost of accidents, occupational diseases. Safety management in mines, role of management, labour, union and government, safety audit, risk identification and management, safety conferences

TEXT BOOKS

1. The Mines Act, 1952
2. The Mines Rules, 1955
3. The Mines Vocational Training Rules, 1966
4. The Employee's (Workmen's) Compensation Act, 2010
5. Indian Electricity Rules, 1956
6. Coal Mines Regulations, 1957
7. Metalliferous Mines Regulations, 1961
8. Mines and Minerals (Regulation and Development) Act 1957

REFERENCE BOOKS:

1. Legislation in Indian Mines: A Critical Appraisal vol. 1&2 – Rakesh and Prasad.
2. The Mineral Concession Rules, 1960
3. The Mineral Conservation and Development Rules, 1988.

MINE ECONOMICS (BT MN801)

Course Objectives:

CO 1. Study of estimation and valuation of mineral deposits

CO 2. Study of project appraisal

CO 3. Study of finance and accounting

Course Outcome: The students will have knowledge on estimation and valuation of mineral deposits. They will possess about project appraisal, finance and accounting.

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Understand basic economic principles and their application in the mining industry.	K2, K3
CO2	Explain methods of mine valuation, cost estimation, and economic feasibility of mining projects.	K4
CO3	Analyze depreciation, taxation, and investment analysis techniques used in mine project evaluation.	K4
CO4	Compare different methods of mineral pricing and marketing**,** including factors affecting mineral demand and supply.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Introduction: Mineral industry and its role in national economy; world and national mineral resources;Mining - A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy.

UNIT - II

Ore Reserve Estimation: Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, introduction to geo-statistica l methods, classification of reserves.

UNIT - III

Mine Valuation: Time value of money; annuity; redemption of capital, net present value; depletion allowance; depreciation; inflation; escalation; rates of return; Hoskold's Two rate method; capital and operating cost including wages, incentives, material, etc.; assets; liabilities; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT - IV

Project Appraisal: Methods of project evaluation – pay back, annual value, benefit/cost ratio, ERR and IRR, etc., evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; mine taxation; critical impact of depreciation, depletion, type of funding, reserves,life, etc. on mine profitability.

UNIT - V

Finance and accounting: Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P & L account, balance sheet, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods.

TEXT BOOKS:

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Arogyaswamy, R.N.P. Courses in Mining Geology, Oxford and IBH Publishing Co., 1994.

REFERENCE BOOKS:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO 1992.

MINERAL EXPLORATION (BT MN802)

Course Objectives: Expose the mining engineer to various aspects of prospecting and exploration methods for search of important ore minerals using different geological, geophysical and geochemicaltechniques.

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

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Explain the principles and objectives of mineral exploration and its role in the mining industry.	K2, K3
CO2	Identify and describe various geological, geophysical, and geochemical methods used in mineral exploration.	K4
CO3	Interpret topographic, geological, and structural maps for locating potential mineral deposits.	K4
CO4	Apply drilling, sampling, and logging techniques for mineral deposit evaluation and resource estimation.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO Average	2.66	2	3			1			2	1.66		

UNIT - I

Geological Prospecting and Exploration: Definitions and Principles; Methods of Prospecting; Methods of Exploration.

UNIT- II

Sampling: theory and methods; Geological plans and sections for orebody evaluation; Exploration drilling, drill core logging and sampling Cut-off grade concepts and applications; Resources and Reserves. Estimation of reserves – methods and practice.

UNIT- III

Geochemical Exploration: Introduction, Geochemical cycle, geochemical mobility and association of elements. Pathfinder and target elements for geochemical exploration. Principles of geophysical exploration methods.

UNIT- IV

Primary and secondary dispersions of elements; Determination of background, and geochemical anomalies; Geo-chemical methods of mineral exploration: Procedures for geochemical sampling; Interpretation of geochemical surveys. Indian case studies.

UNIT- V

Collection of data along Geological (G), Feasibility (F) and Economic (E) axes during various stages ofexploration.

TEXT BOOKS:

1. Reedman, J H. Techniques in Mineral Exploration: 1979. Applied Science Publishers Ltd, UK
2. Peters, W.C. Exploration and Mining Geology (2nd Ed.); 1987. John Wiley & Sons, New York.

REFERENCE BOOKS:

1. Sharma, N L and Agarwal Y K. Tables for Mineral Identification.

2. A.M. Evans. 1997: Ore Geology and Industrial minerals- An introduction (III edn.) Geo- science,Texas.

MINE SUBSIDENCE ENGINEERING (BT MN803)

Course Objectives: To familiarize the student with the specialized knowledge on mechanism, prediction, control of subsidence due to underground mining.

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

Course Outcomes (COs):

CO No.	Course Outcome Description	Bloom's Level
CO1	Explain the concept and causes of mine subsidence and its classification (local, regional, and progressive).	K2, K3
CO2	Analyze the mechanics of subsidence movement and predict subsidence parameters using empirical and theoretical approaches.	K4
CO3	Assess the effects of subsidence on surface structures, land, environment, and utilities.	K4
CO4	Select and recommend appropriate subsidence control and mitigation methods, including preventive and remedial techniques.	K3, K5

CO–PO Mapping Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3						2	1		
CO2	2			1		1			3	3		
CO3	3									1		
CO4		2	3			1			1			
CO	2.66	2	3			1			2	1.66		

Average												

UNIT- I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

1. Whiltaker B.N. Reddish D.J. - Subsidence occurrence prediction and control
2. Kratzsch. H, Mine Subsidence Engineering.

REFERENCE BOOKS:

1. B. Singh – Mine Subsidence
2. Peng.S. – Surface subsidence Engineering