JNTUH UNIVERSITY COLLEGE OF ENGINEERING MANTHANI
B.Tech. in MINING ENGINEERING
COURSE STRUCTURE & SYLLABUS (R25 Regulations)
Applicable from AY 2025-26 Batch

I Year I Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1	BSC	Matrices and Calculus	3	1	0	4
2	BSC	Engineering Physics	3	0	0	3
3	CSC	C Programming and Data Structures	3	0	0	3
4	MEC	Engineering Graphics and Computer Aided Drafting	2	0	2	3
	MEC	Engineering Workshop	0	0	2	1
5	HSC	English for Skill Enhancement	3	0	0	3
6	BSC	Engineering Physics Laboratory	0	0	2	1
7	CSC	C Programming and Data Structures Laboratory	0	0	2	1
8	HSC	English Language and Communication Skills Laboratory	0	0	2	1
9		Induction Program				
		Total Credits	**14**	**01**	**10**	**20**

I Year II Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1	BSC	Ordinary Differential Equations and Vector Calculus	3	0	0	3
2	BSC	Applied Chemistry	3	0	0	3
3	CSC	Python Programming	3	0	0	3
4	ESC	Basic Electrical and Electronics Engineering	3	0	0	3
5	DC	Introduction to Mining Engineering	3	0	0	3
6	MEC	Engineering Mechanics	3	0	0	3
7	BSC	Chemistry Laboratory for Engineers	0	0	2	1
8	CSC	Python Programming Laboratory	0	0	2	1
9	ESC	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
		Total Credits	**18**	**0**	**06**	**21**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	BSC	Probability, Statistics and Complex Variables	3	0	0	3
2	DC	Mine Surveying-I	3	0	0	3
3	DC	Development of Mineral Deposits	3	0	0	3
4	DC	Mining Geology	3	0	0	3
5	DC	Fluid Mechanics and Hydraulic Machines	3	0	0	3
6	BSCL	Mathematics-III Lab	0	0	2	1
7	DCL	Mine Surveying- I Lab	0	0	2	1
8	DCL	Mining Geology Laboratory	0	0	2	1
9	DCL	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
10	SDC	Industrial Training-I	0	0	2	1
		Total Credits	**15**	**0**	**10**	**20**

Note: Skill Development Course-I: (Industrial Training- 1) Open Cast and underground Coal Mines (Must for One week or atleast two days duration). The training program will be conducted during this Semester, and the report is to be submitted for assessment.

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DC	Surface Mining Technology	3	0	0	3
2	DC	Mine Ventilation	3	0	0	3
3	DC	Mine surveying-II	3	0	0	3
4	DC	Mine Mechanization-I	3	0	0	3
5	DC	Underground Coal Mining Technology	2	0	0	2
		Innovation and Entrepreneurship	2	0	0	2
6	DCL	Mine Surveying -II Lab	0	0	2	1.5
7	DCL	Mine Ventilation Lab	0	0	2	1.5
8	DCL	Mine Mechanization- I lab	0	0	2	1
9	SDC	Introduction to Data Science for Mining Engineering	0	0	2	1
10	MC	Indian Knowledge System	1	0	0	0
11	**(Optional)**	**Work-based Vocational Course/ Internship or Apprenticeship**	**0**	**0**	**4**	**2**
		Total Credits	**16**	**0**	**10**	**21**

***Note:** Students who wish to exit after II Year II Semester has to register for this optional course and acquire the credits allotted by doing 6 weeks Work-based Vocational Course/ Internship or Apprenticeship. Please refer R25 Academic Regulations for more information.

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DC	Rock Mechanics	3	0	0	3
2	DC	Mine Mechanization-II	3	0	0	3
3	DC	Mine Hazards and Rescue	3	0	0	3
4	DC	Professional Elective-I	3	0	0	3
5	OE	Open Elective-I	2	0	0	2
6	DCL	Rock Mechanics Lab	0	0	2	1.5
7	DCL	Mine Mechanization -II Lab	0	0	2	1.5
8	DCL	Mine Hazards and Rescue Lab	0	0	2	1
9		Field Based Project/ Internship	0	0	4	2
10	SDC	Environment Management in Mining Lab	0	0	2	1
1	MC	Gender Sensitization Lab*/ Constitution of India*	1	0	0	0
		Total Credits	**15**	**0**	**10**	**21**

***Note: For the courses Gender Sensitization Lab and Constitution of India -** one hour of instruction will be conducted on alternate weeks. For example, if a one-hour class for Gender Sensitization Lab is conducted this week, then a one-hour class for Constitution of India will be conducted in the following week.

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	DC	Mine Planning & Design	3	0	0	3
2	DC	Mineral Processing	3	0	0	3
3	HSC	Fundamentals of Management for Engineers/ Business Economics and Financial Analysis/ Organisational Behaviour	3	0	0	3
4	DC	Professional Elective-II	3	0	0	3
5	OE	Open Elective – II	2	0	0	2
6	DCL	Mineral Processing Lab	0	0	2	1
7	DCL	Ground Control Lab	0	0	2	1
8	DCL	Mine Planning & Design lab	0	0	2	1
9	HSC	Advanced English Communication Skills Laboratory	0	0	2	1
10	SDC	Industrial Training - II	0	0	2	1
11	MC	Environmental Science	1	0	0	1
		Total Credits	**15**	**0**	**10**	**20**

Note: Skill Development Course-I: (Industrial Training- II) Metal Mines (Visit for One week or at least Two days duration). The training program will be conducted during this Semester, and the report is to be submitted for assessment.

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DC	Mine Legislation and General Safety	3	0	0	3
2	DC	Underground metal Mining Technology	3	0	0	3
3	HSC	Fundamentals of Management for Engineers/ Business Economics and Financial Analysis/ E-Business/ Engineering Economics and Accountancy/ Entrepreneurship/ Introduction to Industrial Engineering/ Organisational Behaviour	3	0	0	3
4	DC	Professional Elective-III	3	0	0	3
5	DC	Professional Elective – IV	3	0	0	3
6	OE	Open Elective – III:	2	0	0	2
7	DCL	Computer Applications in Mining Lab	0	0	2	1
8	DCL	Mine Safety Lab	0	0	2	1
9	IOMP	Industry Oriented Mini Project/ Summer Internship	0	0	4	2
		Total Credits	**17**	**0**	**08**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DC	Professional Elective – V	3	0	0	3
2	DC	Professional Elective – VI	3	0	0	3
3		Project Work	0	0	28	14
		Total Credits	**6**	**0**	**28**	**20**

***Note:** Students who wish to exit after II Year II Semester has to register for this optional course and acquire the credits allotted by doing 6 weeks Work-based Vocational Course/ Internship or Apprenticeship. Please refer R25 Academic Regulations for more information.

Professional Elective - I

1	Drilling and Blasting
2	Advanced Surface Mining
3	Material Management in Mines

Professional Elective - II

1	Computer Applications in Mining
2	Dimensional Stone Technology
3	Mining of Deep-Seated Deposits

Professional Elective-III

1	Geo-statistics
2	Mine Systems Engineering
3	Rock Excavation Engineering

Professional Elective-IV

1	Rock Slope Engineering
2	Environmental Management in Mines
3	Rock Fragmentation Engineering

Professional Elective-V

1	Risk Assessment and Management in Mines
2	IoT Applications in Mining
3	GIS and Remote Sensing

Professional Elective-VI

1	Mine Economics
2	Mine Waste Management
3	Sustainable Mining Practices

OPEN ELECTIVES

Open Elective-I:

1	Introduction to Mining Technology
2	Underground Coal Gasification

Open Elective-II:

1	Applications of Geo Statistics
2	Health and Safety in Mines

Open Elective-III:

1	Slope Stability Technology
2	Tunnelling and Underground Space Technology

MATRICES AND CALCULUS

I Year B.Tech. I-Sem

L	T	P	C
3	1	0	4

Pre-Requisites: Mathematical Knowledge at pre-university level

Course Objectives:

To learn

1. Applying basic operations on matrices and their properties.
2. Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
3. Concept of eigen values and eigen vectors and to reduce the quadratic form to canonical form
4. Geometrical approach to the mean value theorems and their application to the mathematical problems
5. Finding maxima and minima of functions of two and three variables.
6. Evaluation of multiple integrals and their applications.

UNIT-I: Matrices **8 L**

Rank of a matrix by Echelon form and Normal form – Inverse of Non-singular matrices by Gauss-Jordan method. System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations. Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors **10 L**

Linear Transformation and Orthogonal Transformation: Eigen values – Eigen vectors and their properties – Diagonalization of a matrix – Cayley-Hamilton Theorem (without proof) – Fnding inverse and power of a matrix by Cayley-Hamilton Theorem. Quadratic forms and Nature of the Quadratic Forms – Reduction of Quadratic form to canonical form by Orthogonal Transformation.

UNIT-III: Single Variable Calculus **10 L** Limit and Continuous of functions and its properties. Mean value theorems: Rolle's theorem – Lagrange's Mean value theorem with their Geometrical Interpretation and applications – Cauchy's Mean value Theorem – Taylor's Series (All the theorems without proof).

Curve Tracing: Curve tracing in cartesian coordinates.

UNIT-IV: Multivariable Calculus (Partial Differentiation and applications) **10 L**

Definitions of Limit and continuity – Partial Differentiation: Euler's Theorem – Total derivative – Jacobian – Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V: Multivariable Calculus (Integration) **10 L** Evaluation of Double Integrals (Cartesian and polar coordinates) – change of order of integration (only Cartesian form) – Change of variables for double integrals (Cartesian to polar). Evaluation of Triple Integrals – Change of variables for triple integrals (Cartesian to Spherical and Cylindrical polar coordinates). Applications: Areas by double integrals and volumes by triple integrals.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Editon, 2016.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

Course Outcomes:

After learning the contents of this paper, the student must be able to

1. Write the matrix representation of a set of linear equations and to analyze the solution of the system of equations
2. Find the Eigen values and Eigen vectors
3. Reduce the quadratic form to canonical form using orthogonal transformations.
4. Solve the applications of the mean value theorems.
5. Find the extreme values of functions of two variables with/ without constraints.
6. Evaluate the multiple integrals and apply the concept to find areas, volumes.

ENGINEERING PHYSICS

I Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

Pre-Requisites: 10+2 Physics

Course Objectives:

1. To understand the wave nature of light and related phenomena such as interference, diffraction and polarization.
2. To explore the acoustic properties of buildings and the generation, detection and applications of ultrasonic waves.
3. To provide a foundation in quantum mechanics and introduce basic principles of quantum computing.
4. To study the classification, properties, and technological applications of magnetic, dielectric and superconducting materials.
5. To understand the principles, types, and applications of lasers and optical fiber communication systems.

UNIT - I: WAVE OPTICS

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Farunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power. Introduction to polarization, double refraction, Nicol's Prism, quarter and half wave plates.

UNIT - II: ACOUSTICS OF BUILDINGS & ULTRASONICS

Introduction to Acoustics of Buildings, Reverberation, Time of Reverberation, Sabine's Formulae, Basic Requirements of Acoustically good hall, Factors affecting the Architectural Acoustics and their Remedies. Introduction to Ultrasonics, Production of Ultrasonics by Piezoelectric and Magnetostriction Methods, Detection of Ultrasonics by Kund's Tube and Quartz Crystal Methods, Applications of Ultrasonics.

UNIT - III: QUANTUM MECHANICS AND QUANTUM COMPUTING

Introduction, de-Broglie hypothesis, Heisenberg uncertainty principle, physical significance of wave function, postulates of quantum mechanics: operators in quantum mechanics, Eigen values and Eigen functions, expectation value; Schrödinger's time independent wave equation, particle in a 1D box. Introduction to Quantum Computing, linear algebra for quantum computation, Dirac's Bra and Ket notation and their properties, Hilbert space, Bloch's sphere, concept of quantum computer, classical bits, Qubits.

UNIT - IV: MAGNETIC AND DIELECTRIC MATERIALS

Introduction to magnetic materials, origin of magnetic moment-classification of magnetic materials, hysteresis, Weiss domain theory of ferromagnetism, soft and hard magnetic materials, introduction to superconductivity; properties, Type – I and Type –II superconductors. Applications of superconductors. Introduction to dielectric materials, types of polarization, electronic and ionic polarizabilities. Ferroelectric, piezoelectric, pyroelectric materials and their applications.

UNIT - V: LASER AND FIBRE OPTICS

Introduction to laser, characteristics of laser, population inversion, pumping, lasing action, Einstein coefficients and their relations, Ruby laser, He-Ne laser, CO_2 laser, semiconductor diode laser, applications of laser. Introduction to fibre optics, total internal reflection, construction of optical fibre, acceptance angle, numerical aperture, classification of optical fibres, losses in optical fibre, optical fibre for communication system, applications.

TEXT BOOKS:

1. Walter Borchardt-Ott, *Crystallography: An Introduction*, Springer.
2. Charles Kittel, *Introduction to Solid State Physics*, John Wiley & Sons, Inc.
3. Thomas G. Wong, *Introduction to Classical and Quantum Computing*, Rooted Grove

REFERENCE BOOKS:

1. Jozef Gruska, *Quantum Computing*, McGraw Hill
2. Michael A. Nielsen & Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press.
3. John M. Senior, *Optical Fiber Communications Principles and Practice*, Pearson Education Limited.

COURSE OUTCOMES:

1. Students will be able to explain and analyze optical phenomena such as interference, diffraction, and polarization using wave theory. *(SDG 9)*
2. Students will demonstrate understanding of architectural acoustics and the generation and detection techniques of ultrasonic waves. *(SDG 4)*
3. Students will apply quantum mechanical concepts like wave functions and Schrödinger's equation and explain the structure of a quantum computer. *(SDG 9)*
4. Students will classify magnetic and dielectric materials and describe their behavior, including superconductivity and various polarization effects. *(SDG 9)*
5. Students will describe laser operation principles and fiber optics fundamentals and apply them in communication and instrumentation systems. *(SDG 9, SDG 7)*

C PROGRAMMING AND DATA STRUCTURES

I Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development

Introduction to C Language – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output Structure of a C Program – Operators, Bit-wise operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Statements.

UNIT - II

Statements – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Recursion.

Designing Structured Programs- Functions, basics, user defined functions, inter function communication, standard functions.

Arrays – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays.

UNIT - III

Pointers – Introduction, Pointers for inter function communication, pointers to pointers, compatibility,

Pointer Applications – Passing an array to a function, Memory allocation functions, array of pointers.

Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion.

UNIT - IV

Derived types – The Typedef, enumerated types, Structures – Declaration, definition and initialization of structures, accessing structures, operations on structures, complex structures. Unions – Referencing unions, initializers, unions and structures.

Input and Output – Text vs Binary streams, standard library functions for files, converting file types, File programs – copy, merge files.

UNIT – V

Sorting- selection sort, bubble sort, insertion sort,

Searching-linear and binary search methods.

Data Structures – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks - Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

Text Books:

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education.

Reference Books:

1. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press.
3. Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
4. C for Engineers and Scientists, H. Cheng, McGraw-Hill International Edition.
5. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education / PHI.
6. C Programming & Data Structures, E. Balagurusamy, TMH.
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press.
8. C & Data structures – E V Prasad and N B Venkateswarlu, S. Chand & Co.

Course Outcomes:

1. Understand the various steps in Program development.
2. Explore the basic concepts in C Programming Language.
3. Develop modular and readable C Programs
4. Understand the basic concepts such as Abstract Data Types, Linear and Non-Linear Data structures.
5. Apply data structures such as stacks, queues in problem solving
6. To understand and analyze various searching and sorting algorithms.

ENGINEERING GRAPHICS AND COMPUTER AIDED DRAFTING

I Year B.Tech. I-Sem

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

1. To develop the ability of visualization of different objects through technical drawings
2. To acquire computer drafting skill for communication of concepts, ideas in the design of engineering products

UNIT – I: Introduction to Engineering Graphics

Principles of Engineering Graphics and their Significance, Geometrical Constructions, Scales – Plain & Diagonal, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid.

Introduction to Computer aided drafting – views, commands and conics

UNIT- II: Orthographic Projections (Conventional and Computer Aided)

Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes.

Computer aided orthographic projections – points, lines and planes.

UNIT – III: (Conventional and Computer Aided)

Projections of Regular Solids - Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views,

Computer aided projections of solids – sectional views

UNIT – IV: Development of Surfaces of Right regular solids

Prism, Cylinder, Pyramid and Cone.

Development of surfaces using computer aided drafting

UNIT – V: Isometric Projections (Conventional and Computer Aided)

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions.

Conversion of orthographic projection into isometric view using computer aided drafting.

TEXT BOOKS:

1. Engineering Drawing, N.D. Bhatt,Charotar, 54th Edition, 2023.
2. Engineering Drawing and graphics Using AutoCAD, T. Jeyapoovan andVikas: S. Chand and company Ltd., 3rdEdition,2010.

REFERENCE BOOKS:

1. Engineering Drawing, Basant Agrawal and C M Agrawal, McGraw Hill, 3rd Edition, 2019.
2. Engineering Graphics and Design, WILEY, John Wiley & Sons Inc, 3rdEdition, 2020.
3. Engineering Drawing, M. B. Shah and B.C. Rane, Pearson, 2nd Edition, 2009.
4. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford, 1st Edition, 2015.
5. Computer Aided Engineering Drawing, K Balaveera Reddy, CBS Publishers, 2nd Edition, 2015.

COURSE OUTCOMES:

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

1. Apply computer aided drafting tools to create 2D and 3D objects
2. sketch conics and different types of solids
3. Appreciate the need of Sectional views of solids and Development of surfaces of solids
4. Read and interpret engineering drawings
5. Conversion of orthographic projection into isometric view and vice versa manually and by using computer aided drafting

Note: - External examination is conducted in conventional mode and internal evaluation to be done by both conventional as well as using computer aided drafting.

ENGINEERING WORKSHOP

I Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

Pre-requisites: Practical skill

Course Objectives:

1. To Study of different hand operated power tools, uses and their demonstration.
2. To gain a good basic working knowledge required for the production of various engineering products.
3. To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
4. To develop a right attitude, team working, precision and safety at work place.
5. It explains the construction, function, use and application of different working tools, equipment and machines.
6. To study commonly used carpentry joints.
7. To have practical exposure to various welding and joining processes.
8. Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

I. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint)
II. Fitting – (V-Fit, Dovetail Fit & Semi-circular fit)
III. Tin-Smithy – (Square Tin, Rectangular Tray & Conical Funnel)
IV. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
V. Welding Practice – (Arc Welding & Gas Welding)
VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
VII. Black Smithy – (Round to Square, Fan Hook and S-Hook)

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

Text Books:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K.Venugopal / Anuradha.

Reference Books:

1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech
2. Workshop Manual / Venkat Reddy/ BSP

Course Outcomes:

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

1. Study and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
3. Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
4. Apply basic electrical engineering knowledge for house wiring practice.

ENGLISH FOR SKILL ENHANCEMENT

I Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

INTRODUCTION

National Education Policy-2020 aims at preparing students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. It also emphasizes language study and promotion of languages through understanding and proper interpretation. English language is central to the educational eco system. The importance of language as medium of communication for personal, social, official and professional needs to be emphasized for clear and concise expression. Teaching and learning of receptive and productive skills viz., Listening, Speaking, Reading and Writing (LSRW) are to be taught and learnt effectively in the undergraduate Engineering programs. Learners should be encouraged to engage in a rigorous process of learning to become proficient users of English language by adopting a deeply focused and yet flexible approach as opposed to rote learning.

In this connection, suitable syllabus, effective pedagogy, continuous assessments and students' involvement result in productive learning. This course supports the latest knowledge and skill requirements and shall meet specified learning outcomes. The main objectives of English language teaching and learning as medium of communication and for promotion of cultural values are embedded in this syllabus. Efforts are being made in providing a holistic approach towards value-based language learning which equips the learner with receptive as well as productive skills.

The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed textbook for detailed study. The students should be encouraged to read the texts leading to reading comprehension. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material.

LEARNING OBJECTIVES

This course will enable the students to:

a. Improve their vocabulary.
b. Use appropriate sentence structures in their oral and written communication.
c. Develop their reading and study skills.
d. Equip students to write paragraphs, essays, précis and draft letters.
e. Acquire skills for Technical report writing.

SYLLABUS

The course content / study material is divided into **Five Units.**

Unit –I

Theme: Perspectives

Lesson on 'The Generation Gap' by Benjamin M. Spock from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Words Often Misspelt - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing with Reference to Parts of Speech particularly Articles and Prepositions – Degrees of Comparison

Reading: Reading and Its Importance- Sub Skills of Reading – Skimming and Scanning.

Writing: Sentence Structures and Types -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing Precisely –Nature and Style of Formal Writing.

Unit –II

Theme: Digital Transformation

Lesson on '*Emerging Technologies*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Reading Strategies-Guessing Meaning from Context – Identifying Main Ideas – Exercises for Practice

Writing: Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence – Linkers and Connectives - Organizing Principles in a Paragraph – Defining- Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence - Essay Writing - Writing Introduction and Conclusion.

Unit –III

Theme: Attitude and Gratitude

Poems on '*Leisure'* by William Henry Davies and '*Be Thankful'* - Unknown Author from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-Skills of Reading – Identifying Topic Sentence and Providing Supporting Ideas - Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with CV/Resume –Difference between Writing a Letter and an Email - Email Etiquette.

Unit –IV

Theme: **Entrepreneurship**

Lesson on '*Why a Start-Up Needs to Find its Customers First*' by Pranav Jain from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Standard Abbreviations in English – Inferring Meanings of Words through Context – Phrasal Verbs – Idioms.

Grammar: Redundancies and Clichés in Written Communication – Converting Passive to Active Voice and Vice-Versa.

Reading: Prompt Engineering Techniques– Comprehending and Generating Appropriate Prompts - Exercises for Practice

Writing: Writing Practices- Note Making-Précis Writing.

Unit –V

Theme: **Integrity and Professionalism**

Lesson on '*Professional Ethics*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Technical Vocabulary and their Usage– One Word Substitutes – Collocations.

Grammar: Direct and Indirect Speech **-** Common Errors in English (Covering all the other aspects of grammar which were not covered in the previous units)

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) – Inferring the Meaning and Evaluating a Text- Exercises for Practice

Writing: ***Report Writing - Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) - Types of Reports - Writing a Technical Report.***

Note: ***Listening and Speaking skills which are given under Unit-6 in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.***

- (**Note**: As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is* ***Open-ended***, besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.)

Prescribed Textbook

1. **Board of Editors. *2025. English for the Young in the Digital World.* Orient BlackSwan Pvt. Ltd.**

REFERENCES:

1. Swan, Michael. (2016). *Practical English Usage.* Oxford University Press. New Edition.
2. *Karal, Rajeevan. 2023. English Grammar Just for You.* Oxford University Press. New Delhi
3. 2024. *Empowering with Language: Communicative English for Undergraduates.* Cengage Learning India Pvt. Ltd. New Delhi
4. Sanjay Kumar & Pushp Lata. 2022. *Communication Skills – A Workbook.* Oxford Univeristy Press. New Delhi
5. Wood,F.T. (2007). *Remedial English Grammar*. Macmillan.
6. Vishwamohan, Aysha. (2013). *English for Technical Communication for Engineering Students.* Mc Graw-Hill Education India Pvt. Ltd.

COURSE OUTCOMES

Students will be able to:

CO1 Choose appropriate vocabulary in their oral and written communication. **(SDG 4, 8)**

CO2 Demonstrate their understanding of the rules of functional grammar and sentence structures. **(SDG 4)**

CO3 Develop comprehension skills from known and unknown passages. **(SDG 4, 8)**

CO4 Write paragraphs, essays, précis and draft letters. **(SDG 4)**

CO5 Write abstracts and reports in various contexts. **(SDG 4, 8)**

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ENGINEERING PHYSICS LABORATORY

I Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

1. To explore the electromagnetic and dielectric behavior of materials through experiments such as B-H curve and dielectric constant determination.
2. To understand fundamental quantum phenomena by experimentally determining physical constants like Planck's constant and work function.
3. To investigate optical phenomena using diffraction, interference (Newton's Rings), and study of optical fiber properties.
4. To characterize the performance of semiconductor and optoelectronic devices like laser diodes, solar cells, and Hall effect sensors.
5. To develop analytical and data fitting skills through experimental modeling and application of the least squares method.

LIST OF EXPERIMENTS

1. Study of B-H curve of a ferromagnetic material.
2. Determination of dielectric constant of a given material.
3. Determination of work function and Planck's constant using photoelectric effect.
4. Determination of wavelength of source using diffraction grating.
5. Study of V-I & L-I characteristics of a given laser diode.
6. Determination of acceptance angle and numerical aperture of a given optical fibre.
7. Newton Rings: to determine the radius of curvature of Plano-convex lens.
8. Determination of energy gap of a semiconductor.
9. Determination of Hall coefficient and carrier concertation of a given semiconductor.
10. Understanding the method of least squares – Torsional pendulum as an example.
11. To study and analyze the characteristics of a solar cell by plotting the V-I (voltage-current) and P-V (power-voltage) curves
12. To determine the frequency of the A.C. mains supply using a sonometer by finding the resonant length of the vibrating wire that matches the frequency of the alternating current.

Note: Any 8 experiments are to be performed.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Analyse magnetic and dielectric properties of materials using B-H curve and dielectric constant experiments. **(SDG 9)**
2. Determine key quantum mechanical constants and validate the photoelectric effect. **(SDG 4, 9)**
3. Measure optical parameters using diffraction gratings and Newton's Rings, and study fiber optic properties. **(SDG 7, 9)**
4. Evaluate characteristics of semiconductor and optoelectronic devices, including energy gap, Hall Effect, laser diodes, LEDs, and solar cells. **(SDG 7, 13)**
5. Apply curve fitting techniques such as the least squares method to analyze experimental data and estimate physical quantities. **(SDG 4, 9)**

C PROGRAMMING AND DATA STRUCTURES LABORATORY

I Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

List of Experiments:

1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
3. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a C program to find the roots of a quadratic equation.
5. Write a C program to find the factorial of a given integer.
6. Write a C program to find the GCD (greatest common divisor) of two given integers.
7. Write a C program to solve Towers of Hanoi problem.
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
9. Write a C program to find both the largest and smallest number in a list of integers.
10. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices
    ii) Multiplication of Two Matrices
11. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins, or –1 if S doesn't contain T.
14. Write a C program to count the lines, words and characters in a given text.
15. Write a C program to generate Pascal's triangle.
16. Write a C program to construct a pyramid of numbers.
17. Write a C program that uses functions to perform the following operations:
    i) Reading a complex number
    ii) Writing a complex number
    iii) Addition of two complex numbers
    iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

18. i. Write a C program which copies one file to another.
    ii. Write a C program to reverse the first n characters in a file.
    (Note: The file name and n are specified on the command line.)
19. i. Write a C program to display the contents of a file.
    ii. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)
20. Write a C program that uses functions to perform the following operations on singly linked list.:
    i) Creation ii) Insertion iii) Deletion iv) Traversal
21. Write C programs that implement stack (its operations) using
    i) Arrays ii) Pointers
22. Write C programs that implement Queue (its operations) using
    i) Arrays ii) Pointers
23. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order
    i) Bubble sort ii) Selection sort iii) Insertion sort
24. Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers:
    i) Linear search ii) Binary search

Text Books:

1. C Programming & Data Structures, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Let us C, Yeswanth Kanitkar
3. C Programming, Balaguruswamy.

Course Outcomes:

1. Develop modular and readable C Programs
2. Solve problems using strings, functions
3. Handle data in files
4. Implement stacks, queues using arrays, linked lists.
5. To understand and analyze various searching and sorting algorithms.

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

I Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

The **English Language and Communication Skills (ELCS) Lab** focuses on listening and speaking skills, particularly on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Listening Skills:

Objectives

1. To enable students develop their active listening skills
2. To equip students with necessary training in listening, so that they can comprehend the speech of people from different linguistic backgrounds

Speaking Skills:

3. To improve their pronunciation and neutralize accent
4. To enable students express themselves fluently and appropriately
5. To practise speaking in social and professional contexts

Learning Outcomes

Students will be able to:

CO1 Listen actively and identify important information in spoken texts **(SDG 4)**
CO2 Interpret the speech and infer the intention of the speaker **(SDG 4)**
CO3 Improve their accent for intelligibility **(SDG 4, 8, 10)**
CO4 Speak fluently with clarity and confidence **(SDG 4, 8, 10)**
CO5 Use the language in real life situations **(SDG 4, 8)**

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:

a. Computer Assisted Language Learning (CALL) Lab which focusses on listening skills
b. Interactive Communication Skills (ICS) Lab which focusses on speaking skills

The following course content is prescribed for the **English Language and Communication Skills Lab**.

Exercise – I

CALL Lab:

Instruction: Speech Sounds-Listening Skill - Importance – Purpose - Types- Barriers- Active Listening

Practice: Listening to Distinguish Speech Sounds (Minimal Pairs) **-** *Testing Exercises*

ICS Lab:

❖ **Diagnostic Test – Activity titled '*Express Your View'***

Instruction: Spoken and Written language - Formal and Informal English - Greetings - Introducing Oneself and Others

Practice: Any Ice-Breaking Activity

Exercise – II

CALL Lab:

Instruction: Listening vs. Hearing - Barriers to Listening

Practice: Listening for General Information - Multiple Choice Questions - *Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)*

ICS Lab:

Instruction: Features of Good Conversation – Strategies for Effective Communication

Practice: Role Play Activity - Situational Dialogues –Expressions used in Various Situations –Making Requests and Seeking Permissions – Taking Leave - Telephone Etiquette

Exercise - III

CALL Lab:

Instruction: Errors in Pronunciation – Tips for Neutralizing Mother Tongue Influence (MTI)

Practice: Differences between British and American Pronunciation *–Listening Comprehension Exercises*

ICS Lab:

Instruction: Describing Objects, Situations, Places, People and Events

Practice: Picture Description Activity – Looking at a Picture and Describing Objects, Situations, Places, People and Events *(A wide range of Materials / Handouts are to be made available in the lab.)*

Exercise – IV

CALL Lab:

Instruction: Techniques for *Effective* Listening

Practice: Listening for Specific Details - Listening - Gap Fill Exercises - *Listening Comprehension Exercises*

(It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: How to Tell a Good Story - Story Star- Sequencing-Creativity

Practice: Activity on Telling and Retelling Stories - Collage

Exercise – V

CALL Lab:

Instruction: Identifying the literal and implied meaning

Practice: Listening for Evaluation - Write the Summary – Listening Comprehension Exercises

(It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: Understanding Non-Verbal Communication

Practice: Silent Speech - Dumb Charades Activity

❖ **Post-Assessment Test on 'Express Your View'**

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V. or LCD, a digital stereo – audio & video system and camcorder etc.

✍ **Note: English Language Teachers are requested to prepare Materials / Handouts for each Activity for the Use of those Materials in CALL & ICS Labs.**

Suggested Software:

- Cambridge Advanced Learners' English Dictionary with CD.
- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.

- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).

REFERENCES:

1. Shobha, KN & Rayen, J. Lourdes. (2019). *Communicative English – A workbook.* Cambridge University Press
2. Board of Editors. (2016). *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient BlackSwan Pvt. Ltd.
3. Mishra, Veerendra et al. (2020). *English Language Skills: A Practical Approach.* Cambridge University Press
4. (2022). *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd.
5. Ur, Penny and Wright, Andrew. 2022. *Five Minute Activities – A Resource Book for Language Teachers.* Cambridge University Press.

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ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Mathematical Knowledge at pre-university level

Course Objectives:

To learn

1. Methods of solving the differential equations of first and higher order.
2. Concept, properties of Laplace transforms.
3. Solving ordinary differential equations using Laplace transforms techniques.
4. The physical quantities involved in engineering field related to vector valued functions
5. The basic properties of vector valued functions and their applications to line, surface and volume integrals

UNIT-I: First Order Ordinary Differential Equations **8 L**

Exact differential equations-Equations reducible to exact differential equations – linear and Bernoulli's equations-Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling – Law of natural growth and decay.

UNIT-II: Ordinary Differential Equations of Higher Order **10 L**

Higher order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$ – Method of variation of parameters.

UNIT-II: Laplace Transforms **10 L** Laplace Transforms: Laplace Transform of standard functions – First shifting theorem – Laplace transforms of functions multiplied by 't' and divided by 't' – Laplace transforms of derivatives and integrals of function – Evaluation of integrals by Laplace transforms – Laplace transform of periodic functions – Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

UNIT-IV: Vector Differentiation **10 L** Vector point functions and scalar point functions – Gradient – Divergence and Curl – Directional derivatives – Vector Identities – Scalar potential functions – Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration **10 L** Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5thEditon, 2016.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
4. H. K. Dass and Er. RajnishVerma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

Course Outcomes:

After learning the contents of this paper, the student must be able to

1. Identify whether the given differential equation of first order is exact or not
2. Solve higher differential equation and apply the concept of differential equation to real world problems.
3. Use the Laplace Transforms techniques for solving Ordinary Differential Equations.
4. Evaluate the Line, Surface and Volume integrals and converting them from one to another.

APPLIED CHEMISTRY

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Course Objectives:

1. To develop adaptability to new advances in Engineering Chemistry and acquire the essential skills to become a competent engineering professional.
2. To understand the industrial significance of water treatment, fundamental principles of battery chemistry, and the impact of corrosion along with its control methods for structural protection.
3. To impart foundational knowledge of various energy sources and their practical applications in engineering.
4. To equip students with an understanding of smart materials, biosensors, and analytical techniques applicable in engineering, industrial, environmental, and biomedical fields.

UNIT-I: Water and its treatment: [8]

Introduction, types of hardness and units– Estimation of hardness of water by complexometric method - Numerical problems. Potable water and its specifications (WHO) - Steps involved in the treatment of potable water – Disinfection of potable water by chlorination and break-point chlorination. Defluoridation- Nalgonda technique.

Boiler troubles: Scales, Sludges and Caustic embrittlement. Internal treatment of boiler feed water - Calgon conditioning, Phosphate conditioning, Colloidal conditioning. External treatment methods - Softening of water by ion- exchange processes. Desalination of brackish water - Reverse osmosis.

Unit-II: Electrochemistry and Corrosion: [8]

Introduction- Electrode potential, standard electrode potential, types of electrodes, Nernst equation (no derivation), Galvanic cell, cell representation, EMF of cell- Numerical problems. Reference electrodes - Primary reference electrode – Standard Hydrogen Electrode (SHE), Secondary reference electrode - Calomel electrode. Determination of pH of an unknown solution using SHE and Calomel electrode.

Corrosion: Introduction - Definition**,** causes and effects of corrosion - Theories of corrosion, chemical and electrochemical corrosion - Mechanism of electrochemical corrosion, Types of corrosion: galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion - Nature of the metal, Nature of the corroding environment. Corrosion control methods - Cathodic protection Methods - Sacrificial anode and impressed current methods.

UNIT–III: Energy Sources: [8]

Batteries: Introduction – Classification of batteries - Primary, secondary and reserve batteries with examples. Construction, working and applications of Zn-air and Lithium ion battery. Fuel Cells – Differences between a battery and a fuel cell, construction and applications of Direct Methanol Fuel Cell (DMFC).

Fuels: Introduction and characteristics, Calorific value of fuel - HCV, LCV- Dulongs formula - Numerical problems.

Fossil fuels: Introduction, classification, Petroleum- Refining of Crude oil, Cracking - Moving bed

catalytic cracking. LPG and CNG - composition and uses.
Synthetic Fuels: Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen.

UNIT - IV: Polymers: [8]
Definition, classification of polymers: Based on origin and tacticity with examples - Types of polymerization - Addition (free radical addition mechanism) and condensation polymerization.
Plastics, Elastomers and Fibers: Definition and applications (PVC, Buna-S, Nylon-6,6). Themoplastics and thermo setting plastics, Fiber reinforced plastics (FRP).
Conducting polymers: Definition and classification with examples - Mechanism of conduction in trans-polyacetylene and applications of conducting polymers.
Biodegradable polymers: Polylactic acid(PLA) and its applications.

UNIT-V - Applications of Materials: [8]
Cement: Portland cement, its composition, setting and hardening.
Phase rule: Definition – Phase, component, degrees of freedom. Phase rule equation. Phase diagrams - One component system - water. Two component system - Lead silver system.
Lubricants: Definition and characteristics of a good lubricant – thin film mechanism of lubrication, properties of lubricants - viscosity, cloud and pour point, flash and fire point.
Interpretative spectroscopic applications of UV-Visible spectroscopy for Analysis of pollutants in dye industry, IR spectroscopy in night vision-security, Pollution Under Control- CO sensor (Passive Infrared detection).

Suggested Text Books:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010.
2. Engineering Chemistry by Rama Devi, Dr. P. Aparna and Rath, Cengage learning, 2025.

Reference Text Books:

1. Engineering Chemistry: by Thirumala Chary Laxminarayana&Shashikala, Pearson Publications (2020)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011.
3. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi 2015.
4. Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007.
5. Challenges and Opportunities in Green Hydrogen by Paramvir Singh, Avinash Kumar Agarwal, Anupma Thakur, R.K Sinha.
6. Raman Spectroscopy in Human Health and Biomedicine,https://www.worldscientific.com/doi/epdf/10.1142/13094
7. E-Content- https://doi.org/10.1142/13094 | October 2023

PYTHON PROGRAMMING

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Prerequisites: Basic knowledge of computer fundamentals, C programming.

Course Objectives

1. Introduce the fundamentals of Python programming for problem-solving.
2. Develop skills to write structured, modular, and efficient Python code.
3. Enable students to use Python's built-in data structures and libraries effectively.
4. Provide knowledge on file handling, exception handling, and object-oriented programming in Python.
5. Equip students with the ability to apply Python for real-world applications including data processing and automation.

Unit 1 – Introduction to Python and Basics of Programming

Introduction to Python: Features, Applications, Installation, IDEs, Python Syntax, Indentation, Comments, Variables, Data Types, Type Casting, Operators: Arithmetic, Relational, Logical, Assignment, Membership, Identity, Bitwise, Input/Output functions (input(), print()), Control Structures: if, if-else, if-elif-else, Nested Conditions, Looping: for, while, Nested Loops, break, continue, pass.

Unit 2 – Data Structures in Python

Strings: Creation, Indexing, Slicing, Methods, String Formatting, Lists: Creation, Indexing, Slicing, List Comprehension, Methods, Tuples: Properties, Indexing, Methods, Sets: Creation, Operations, Methods, Dictionaries: Creation, Access, Methods, Dictionary Comprehension, Iterating over data structures.

Unit 3 – Functions and Modules

Functions: Defining, Calling, Parameters, Return Values, Types of Arguments: Positional, Keyword, Default, Variable Length, Scope of Variables: Local and Global, Lambda Functions, Map, Filter, Reduce, Recursion in Python, Modules: Importing, Creating User-defined Modules, Standard Modules (math, random, datetime), Packages in Python.

Unit 4 – File Handling and Exception Handling

File Handling: Opening, Reading, Writing, Appending, File Modes, File Methods, Working with CSV and JSON Files, Exception Handling: try, except, else, finally, Built-in Exceptions, Raising Exceptions, Introduction to Regular Expressions (re module).

Unit 5 – Object-Oriented Programming and Applications

OOP Basics: Classes, Objects, Attributes, Methods, Constructor (__init__), self keyword, Inheritance: Single, Multiple, Multilevel, Hierarchical, Method Overriding, Method Overloading (conceptual),

Encapsulation and Polymorphism, Application Development: Data Processing Script, Basic Calculator, File Organizer, Simple Data Analysis with pandas.

Text Books

1. Python Programming: Using Problem Solving Approach by ReemaThareja
2. Python Crash Course by Eric Matthes, Learning Python by Mark Lutz

Reference Books

1. Introduction to Python Programming by Gowrishankar S., Veena A.
2. Python Cookbook by David Beazley and Brian K. Jones.
3. Fluent Python by Luciano Ramalho, Automate the Boring Stuff with Python by Al Sweigart.

Course Outcomes

1. Write Python programs using variables, operators, expressions, and control structures.
2. Implement Python programs using built-in data structures like lists, tuples, sets, and dictionaries.
3. Apply modular and object-oriented programming principles in Python.
4. Handle files, exceptions, and apply Python libraries for problem-solving.
5. Develop small-scale applications in Python for automation and data manipulation.

CO - PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	1	0	0	2	2	1	3
CO2	3	3	3	2	3	1	0	0	2	2	1	3
CO3	3	3	3	2	3	1	0	1	2	2	1	3
CO4	3	3	2	2	3	1	0	1	2	2	1	3
CO5	3	3	3	2	3	1	1	1	3	3	2	3

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Course Objectives:

The course should enable the students to:

1. Provide foundational understanding of DC and AC circuit concepts, analysis techniques, and three-phase system fundamentals.
2. Familiarize students with electrical installation components, safety devices, energy calculations, and battery backup systems.
3. Develop knowledge of construction, principles, equations, and performance characteristics of electrical machines and transformers.
4. Impart understanding of semiconductor diodes, rectifiers, and filter circuits for basic electronic power conversion.
5. Introduce transistor devices (BJT, FET), their configurations, comparisons, and biasing methods for amplification applications.

UNIT-I: D.C. CIRCUITS AND A.C. CIRCUITS

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL and KCL, analysis of simple circuits with dc excitation.

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits, Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-II: ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT-III: ELECTRICAL MACHINES

Construction and Working principle of Single-phase transformer, EMF equation, Three phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equation, Construction and working principle of Three phase Induction motor, Construction and working principle of synchronous generators.

UNIT-IV: P-N JUNCTION & ZENER DIODE AND RECTIFIERS & FILTERS

P-N Junction and Zener Diode: Principle of Operation P-N junction Diode, Volt - Ampere characteristics, Temperature dependence, Ideal versus practical, Zener diode characteristics and applications.

Rectifiers and Filters:P-N junction as a rectifier, Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Filters – Inductor Filters, Capacitor Filters.

UNIT-V: BIPOLAR JUNCTION TRANSISTOR (BJT) AND FIELD EFFECT TRANSISTOR (FET)

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET.

TextBooks:

1. Basic Electrical and electronics Engineering, M.S. Sukija and T.K. Nagasarkar, Oxford University press, 1st Edition, 2012.
2. Basic Electrical and electronics Engineering, D.P. Kothari and I.J. Nagarath, McGraw Hill Education, 2nd Edition,2020.

Reference Books:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI, 9th Edition, 2006.
2. Millman's Electronic Devices and Circuits, J. Millman,C. C. Halkias and SatyabrataJit, TMH, 2nd Edition, 1998.
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971.
4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press 2nd Edition, 2004.
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005.
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011.
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th Edition 2003.
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010.
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989.

Online Resources:

1. https://nptel.ac.in/courses/108105112
2. https://nptel.ac.in/courses/108102185

Course Outcomes: After completion of course, the student should be able to:

1. Analyze DC and AC circuits, apply KVL/KCL, and determine electrical quantities in single-phase and three-phase balanced systems.
2. Identify and select appropriate LT switchgear, wiring, and battery systems; perform basic calculations for energy consumption and power factor improvement.
3. Explain the construction, working principles, and fundamental equations (EMF, torque) of transformers, DC machines, induction motors, and synchronous generators.
4. Explain the construction, working principles, and fundamental equations (EMF, torque) of transformers, DC machines, induction motors, and synchronous generators.
5. Compare the operation and configurations of BJT and FET devices, and explain their suitability for amplification applications.

INTRODUCTION TO MINING ENGINEERING

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Course Objectives: Student is expected:

1. To learn about mining industry and its role in nation economy.
2. To know the basic mining operations and mining methods.
3. To understand environmental issues due to mining.

UNIT-I

Introduction to Indian mining industry - importance of mining industry and comparison with other industries; The role of mining industry in economic growth of India.

UNIT-II

National and International Scenario of reserves and production regarding coal and lignite, Iron ore, Copper ore, limestone, gold, lead and zinc, uranium, beach sands and granite.

UNIT-III

Unit operations: Drilling, blasting, loading, transportation and size reduction and supports in underground mining and opencast mines.

UNIT-IV

Introduction to mining methods: underground mining methods and surface mining methods in brief.

UNIT-V

Introduction to mine ventilation, environment and safety.

Textbooks / Reference Books:

1. Elements of Mining Technology, D.J. Deshmukh, Volume I and II
2. Introductory Mining Engineering, H.L. Hartman
3. Surface Mining Technology, S.K. Das

Course Outcomes: Student will:

1. Gain knowledge of mining importance and its role in nation growth.
2. Acquire the knowledge of reserves and production in India and other countries of important minerals.
3. Get exposure of mining operations such as drilling, blasting, loading and transportation.
4. Understand the mining methods of underground and open cast.
5. Know the concepts of mine ventilation and environment

ENGINEERING MECHANICS

I Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Course Objectives: The objectives of this course are to

1. Explain the resolution of a system of forces, compute their result ant and solve problems using equations of equilibrium
2. Perform analysis of bodies lying on rough surfaces.
3. Locate the centroid of a body and compute the are a moment of inertia and mass moment of inertia of standard and composite sections
4. Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
5. Explain the concepts of work-energy method and its applications to translation, rotation and plan emotion and the concept of vibrations

UNIT- I:

Introduction to Engineering Mechanics-Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant-Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

UNIT- II:

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. - Theorem of Pappus

UNIT-III:

Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

Mass Moment of Inertia: Moment of Inertia of Masses-Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT- IV:

Area moments of Inertia: Introduction – Definition of Moment of Inertia -Polar Moment of Inertia – Radius of gyration - Transfer Theorem for moment of inertia – Moments of inertia by integration - Moments of Inertia of Composite Figures.

Mass Moment of Inertia: Introduction - Moment of Inertia of Masses – Radius of gyration - Transfer Formula for Mass Moments of Inertia – Mass moments of inertia by integration - Mass moment of inertia of composite bodies.

UNIT- V:

Kinetics of Rigid Bodies - Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications inplane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Text books:

1. Shames and Rao (2006), Engineering Mechanics, Pearson Education
2. K. Vijay Kumar Reddy and J. Suresh Kumar (2010), Singer's Engineering Mechanics - Statics & Dynamics

Reference Books:

1. Beer F.P & Johnston E.R Jr, Vector Mechanics for Engineers Statics and Dynamics, Mc Graw Hill, 12th Edition.
2. Dumir P.C, Sengupta, Srinivas, Engineering Mechanics - Universities Press, 2020.
3. Hibbeler R.C, Engineering Mechanics, Pearson, 14th Edition.
4. Arshad Noor, Zahid & Goel, Engineering Mechanics, Cambridge University Press, 2018.
5. Khurmi R.S, Khurmi N., Engineering Mechanics, S. Chand, 2020.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press

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

1. Determine resultant of for cesacting on a body and analyse equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

CHEMISTRY LABORATORY FOR ENGINEERS

I Year B.Tech. II-Sem

L	T	P	C
0	0	2	1

Course Objectives:

1. Students will understand and perform experiments based on core chemical principles relevant to engineering applications.
2. Students will learn to estimate the hardness of water to assess its suitability for drinking purposes.
3. Students will acquire the ability to perform acid-base titrations using instrumental methods such as conductometry, potentiometry, and pH metry.
4. Students will gain hands-on experience in synthesizing polymers like Bakelite and Nylon – 6, 6 in the laboratory.

List of Experiments:

I. Volumetric Analysis: Estimation of Hardness of water by EDTA Complexometry method.

II. Conductometry:

1. Estimation of the concentration of strong acid by Conductometry.
2. Estimation of the concentration of strong and weak acid in an acid mixture by Conductometry.

III. Potentiometry:

1. Estimation of concentration of Fe^{+2}ion by Potentiometry using $KMnO_4$.
2. Estimation of concentration of strong acid with strong base by Potentiometry using quinhydrone

IV. pH Metry: Determination of an acid concentration using pH meter.

V. Preparations:

1. Preparation of Bakelite.
2. Preparation Nylon – 6, 6.

VI. Corrosion: Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.

VII. Lubricants:

1. Estimation of acid value of given lubricant oil.
2. Estimation of viscosity of lubricant oil using Ostwald's Viscometer.

VIII. Virtual lab experiments

1. Construction of Fuel cell and it's working.
2. Smart materials for Biomedical applications
3. Batteries for electrical vehicles.
4. Functioning of solar cell and its applications.

Reference Books:

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's text book of practical organic chemistry 5thedition.
3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007).

Course Outcomes:

1. Students will develop practical skills through hands-on chemistry experiments relevant to engineering. (SDG 4, 9)
2. Students will learn to determine important parameters such as water hardness and the corrosion rate of mild steel under various conditions. (SDG 6, 12)
3. Students will be able to apply techniques like conductometry, potentiometry, and pH metry to determine concentrations or equivalence points in acid-base reactions. (SDG 4,9)
4. Students will gain experience in synthesizing polymers such as Bakelite and Nylon-6,6. (SDG 9, 12)
5. Students will understand the working principle of Colorimetry and the relationship between absorbance and concentration (Beer-Lambert Law). (SDG 3, 13)

PYTHON PROGRAMMING LABORATORY

I Year B.Tech. II-Sem

L	T	P	C
0	0	2	1

Course Objectives:

1. To install and run the Python interpreter
2. To learn control structures.
3. To Understand Lists, Dictionaries in python
4. To Handle Strings and Files in Python

Note: The lab experiments will be like the following experiment examples.

List of Experiments:

1.
   I. Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.
   II. Start the Python interpreter and type help() to start the online help utility.
1. Start a Python interpreter and use it as a Calculator.
2. Write a program to calculate compound interest when principal, rate and number of periods are given.
3. Read the name, address, email and phone number of a person through the keyboard and print the details.
4. Print the below triangle using for loop.
   5
   4 4
   3 3 3
   2 2 2 2
   1 1 1 1 1
5. Write a program to check whether the given input is digit or lowercase character or uppercase character or a special character(use 'if-else-if' ladder)
6. Python program to print all prime numbers in a given interval (use break)
7. Write a program to convert a list and tuple into arrays.
8. Write a program to find common values between two arrays.
9. Write a function called palindrome that takes a string argument and returnsTrue if it is a palindrome and False otherwise. Remember that you can use the built-in function len to check the length of a string.
10. Write a function called is_sorted that takes a list as a parameter and returns True if the list is sorted in ascending order and False otherwise.
11. Write a function called has_duplicates that takes a list and returns True if there is any element that appears more than once. It should not modify the original list.
12. Write a function called remove_duplicates that takes a list and returns a new list with only the unique elements from the original. Hint: they don't have to be in the same order.
13. The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add "I", "a", and the empty string.
14. Write a python code to read dictionary values from the user. Construct a function to invert its content. i.e., keys should be values and values should be keys.
15. Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'
16. Remove the given word in all the places in a string?

17. Write a function that takes a sentence as an input parameter and replaces the first letter of every word with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?
18. Writes a recursive function that generates all binary strings of n-bit length
19. Write a python program that defines a matrix and prints
20. Write a python program to perform multiplication of two square matrices
21. How do you make a module? Give an example of construction of a module using different geometrical shapes and operations on them as its functions.
22. Use the structure of exception handling all general-purpose exceptions.
23. Write a function called draw_rectangle that takes a Canvas and a Rectangle as arguments and draws a representation of the Rectangle on the Canvas.
24. Add an attribute named color to your Rectangle objects and modify draw_rectangle so that it uses the color attribute as the fill color.
25. Write a function called draw_point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas.
26. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw_circle that draws circles on the canvas.
27. Write a python code to read a phone number and email-id from the user and validate it for correctness.
28. Write a Python code to merge two given file contents into a third file.
29. Write a Python code to open a given file and construct a function to check for given words present in it and display on found.
30. Write a Python code to Read text from a text file, find the word with most number of occurrences
31. Write a function that reads a file *file1*and displays the number of words, number of vowels, blank spaces, lower case letters and uppercase letters.
32. Import numpy, Plotpy and Scipy and explore their functionalities.
33. Install NumPypackage with pip and explore it.
34. Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR
35. Write a GUI program to create a window wizard having two text labels, two text fields and two buttons as Submit and Reset.

Text Books:

1. Supercharged Python: Take your code to the next level, Overland
2. Learning Python, Mark Lutz, O'reilly

Reference Books:

1. Python Programming: A Modern Approach, VamsiKurama, Pearson
2. Python Programming A Modular Approach with Graphics, Database, Mobile, and Web Applications, SheetalTaneja, Naveen Kumar, Pearson
3. Introduction to Python Programming, Gowrishakar S, Veena A, CRC Press
4. Programming with Python, A User's Book, Michael Dawson, Cengage Learning, India Edition
5. Python forData Science, Dr.Mohd Abdul Hameed, Wiley publications
6. Core Python Programming, Dr.R.Nageswara Rao, Dreamtechpress
7. Introduction to Python, Gowrishankar S, Veena A., CRC Press

Course Outcomes: After completion of the course, the student should be able to

1. Develop the application specific codes using python.
2. Understand Strings, Lists, Tuples and Dictionaries in Python
3. Verify programs using modular approach, file I/O, Python standard library
4. Implement Digital Systems using Python

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

I Year B.Tech. II-Sem

L	T	P	C
0	0	2	1

Pre requisites: Basic Electrical and Electronics Engineering

Course Objectives: The course should enable the students to:

1. Demonstrate the constructional details of electrical machines and LT switchgear components through cut-out sections and models.
2. Apply and verify fundamental circuit laws, theorems, and power measurement techniques in DC, single-phase, and three-phase systems.
3. Conduct experiments on transformers, DC motors, induction motors, and alternators to evaluate their performance characteristics.
4. Perform experiments on diodes, rectifiers, transistors, and FETs to study their behavior and applications.
5. Acquire hands-on skills in using measuring instruments such as CRO, multimeters, function generators, and regulated power supplies in laboratory experiments.

List of Experiments:

PART A: ELECTRICAL

1. Verification of KVL and KCL.
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a SinglePhase Transformer (ii) Verification of Relationship between Voltages and Currents (StarDelta, DeltaDelta, Delta Star, StarStar) in a Three Phase Transformer.
3. Measurement of Active and Reactive Power in a balanced Threephase circuit.
4. Performance Characteristics of a Separately Excited DC Shunt Motor.
5. Performance Characteristics of a Threephase Induction Motor.
6. NoLoad Characteristics of a Threephase Alternator.

PART B: ELECTRONICS

1. Study and operation of (i) Multimeters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. P-N Junction diode characteristics.
3. Zener diode characteristics and Zener as voltage Regulator.
4. Input and Output characteristics of Transistor in CB, CE configuration.
5. Full Wave Rectifier with and without filters.
6. Input and Output characteristics of FET in CS configuration.

Text Books:

1. Basic Electrical and electronics Engineering, M.S. Sukija and T.K. Nagasarkar, Oxford University press, 1stEdition, 2012.

2. Basic Electrical and electronics Engineering, D.P. Kothari and I.J. Nagarath, McGraw Hill Education, 2nd Edition,2020.

Reference Books:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI, 9th Edition, 2006.
2. Millman's Electronic Devices and Circuits, J. Millman,C. C. Halkias and Satyabrata Jit, TMH, 2nd Edition, 1998.
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971.
4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press 2nd Edition, 2004.
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005.
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011.
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th Edition 2003.
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010.
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989.

Online Resources:

1. https://nptel.ac.in/courses/108105112
2. https://nptel.ac.in/courses/108102185

Course Outcomes: After completion of course, the student should be able to:

1. Demonstrate and explain the constructional features of electrical machines and LT switchgear components.
2. Verify experimentally KVL, KCL, network theorems, transformer voltage/current relationships, and AC power measurement.
3. Determine experimentally the performance characteristics of DC shunt motors, three-phase induction motors, and alternators.
4. Analyze the characteristics and applications of PN junction diode, Zener diode, rectifiers, transistor, and FET through experiments.
5. Operate and use effectively CRO, multimeters, function generators, and regulated power supplies for measurement and testing in laboratory experiments.

Probability, Statistics & Complex Variables

(Common for ME/Mining Engg./Textile Engg.)

II Year I Semester

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses of first year of study.

Objectives:

To learn

7. The ideas of random variables and various discrete and continuous probability distributions and their properties.
8. The statistical methods of studying data samples.
9. Differentiation and integration of complex valued functions.
10. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
11. Expansion of complex functions using Taylor's and Laurent's series.

UNIT-I: Random Variables and Probability Distributions 8 L

Concept of a Random Variable – Discrete Probability Distributions – Continuous Probability Distributions – Mean of a Random Variable – Variance of a Random Variable

Discrete Probability Distributions: Binomial Distribution – Poisson distribution

UNIT-II: Continuous Distributions and sampling 10 L

Uniform Distribution – Normal Distribution – Areas under the Normal Curve – Applications of the Normal Distribution – Normal Approximation to the Binomial Distributions. **Fundamental Sampling Distributions:** Random Sampling – Some Important Statistics – Sampling Distributions – Sampling Distribution of Means – Central Limit Theorem.

UNIT-III: Tests of Hypotheses (Large and Small Samples) 10 L

Statistical Hypotheses: General Concepts – Testing a Statistical Hypothesis. Single sample: Tests concerning a single mean.Two samples: Tests on two mean (Unknown for equal variance). One sample: Test on a single proportion. Two samples: Tests on two proportions. Two- sample tests concerning variances: F-distribution

UNIT-IV: Complex Differentiation 10 L

Differentiation of Complex functions – Analyticity – Cauchy-Riemann equations (without proof) – Harmonic Functions – Finding harmonic conjugate – Milne Thomson method – Elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Integration 10 L

Line integral – Cauchy's theorem – Cauchy's Integral formula – Zeros of analytic functions – Singularities – Taylor's series – Laurent's series. Residues – Cauchy Residue theorem (All theorems without Proof).

Course outcomes:

After learning the contents of this paper, the student must be able to

7. Apply the concepts of Random variable and distributions to some case studies.
8. Correlate the concepts of one unit to the concepts in other units.
9. Understood sampling theory and apply hypothesis testing in real-world scenarios
10. Analyze the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
11. Taylor's and Laurent's series expansions in complex function

Text Books

3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
4. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications.

References

5. T.T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, Ltd, 2004.
6. Sheldon M Ross, Probability and statistics for Engineers and scientists, academic press.

MINE SURVEYING - I

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

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:

1. The students obtain the knowledge of plane surveying, remote surveying, GIS and total station.
2. Acquire the concepts of levelling and handling of levelling equipments.
3. Get the exposure theodolite and its traversing techniques.
4. Understand the procedures for evaluation of areas, volumes of open pit, dumps and reservoirs.
5. Know the knowledge of correlation and modern techniques of survey.

UNIT – I

Introduction to surveying: Objectives and classification. Principles of surveying, types of surveying: plane and Geodetic.

Linear measurements: Chain, tapes, errors in chaining and corrections in linear measurement. Direct and indirect ranging, principles of chain surveying, offsets. Baking field notes, obstacles in chaining, instruments for setting out right angles.

UNIT-II

Angular measurement (compass surveying) Theory of magnetism, Dip of magnetic needles, prismatic compass, surveyor's compass, bearing and azimuth, declination computation of angles. Errors in compass survey. (Magnetic declination), advantages and disadvantages of compass(dial)survey.

UNIT-III

Introduction to Levelling

Terminologies. levelling instrument: component temporary and permanent adjustments. Methods of leveling – Fly levelling, differential levelling and reciprocal levelling, check levelling, longitudinal sections, cross sectioning, trigonometrical levelling. Methods of baking and reduction of levels

Computation of and volumes: Areas/volumes from field notes, computation of areas along irregular boundaries and regular boundaries. Embankments and cutting, determination of capacity of reservoir/volumes.

UNIT-IV

Characteristics of contour lines and uses of contour lines on mine plan, methods of conducting contour surveys – their plotting

Theodolite – basic definitions, Temporary and Permanent Adjustments, Measurement of horizontal and vertical angles. Principles of Traversing, open traverse and closed traverse using chain /compass / theodolite, Bowditch correction.

Principles of triangulation survey, triangulation using chain, campus and theodolite, basic figures used in triangulation.

UNIT-V

Plane table surveying(PTS) principles of plane tabling, instruments used, working operation, methods of Plane table surveying, two and three point problems. Advantages and disadvantages in Plane table surveying.

TEXT BOOKS:

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

2. “Surveying (Vol-1 &2), DUGGAL S K Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2004
3. Text book of surveying by C. Venkataramaiah, Universities Press.
4. Surveying (Vol 1 & 2) – Kanitkar
5. Mine Surveying (Vol 1 & 2) by Ghatak, Lovely Prakasan publishers, Dhanbad.

REFERENCE BOOKS:

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

DEVELOPMENT OF MINERAL DEPOSITS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: Course introduces underground and surface mining methods along with the associated activities such as drilling, blasting and supporting 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: At the end of the course the student will be able to

1. Know the status and significance of mining Industry.
2. Apply different methods of Shaft sinking according to the ground conditions.
3. Know about Development of workings.
4. Know about different types of supports, their advantages and disadvantages.
5. Know about different tunneling methods.

UNIT-I

Historical overview of mining, Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology, stages/operation in the life of the mine, introduction to underground and surface mining methods. Positive and negative aspects of mining.

UNIT-II

Introduction to drilling and drilling equipment. Types of explosives used for open cast and underground mining methods, initiating devices, short firing tools.

UNIT-III

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 rising.

UNIT-IV

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

UNIT-V

Objectives of mine supports, Types of supports; hydraulic props, Roof bolts, Powered supports, Timber supports, Roadway support, face supports, side supports, junction supports, supports in special conditions, setting and withdrawal of supports, systematic supporting Rules.

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

MINING GEOLOGY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

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 recognition of important minerals and rock units and their physic-mechanical properties, genesis, concepts of mineral prospecting, basic engineering geological aspects which is of immense use in mining engineering practices and tunneling projects.

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

1. Know different types of land forms formed by rivers, wind, oceans and volcanoes.
2. Know igneous rocks, Sedimentary rocks, and metamorphic rocks.
3. Know Structural Geology and Stratigraphy.
4. Know Genesis of Mineral deposits and Mineral Resources of India.
5. Know Geological, geophysical and geochemical exploration of mineral deposits.

UNIT-I

Mineralogy: Physical properties, chemical composition and mode of occurrence of important rock-forming and ore-forming minerals and industrial minerals. Petrology: Distinguish characteristic features, mode of formation and mode of occurrence of important igneous, sedimentary and metamorphic rocks.

UNIT-II

Different types of mineral deposits and their classifications, engineering uses of important rocks.
Genesis of Mineral Deposits: Definition of ore, gangue, tenor and grade of ore, processes and formation of ore deposits including coal, petroleum and atomic minerals.

UNIT-III

Structural Geology: Strike and Dip, Fundamental types, characteristic features and mechanics of folds, faults, joints (fractures) and unconformities. Foliation, lineation and other structural controls. Determination of strata thickness, Dip and Strive calculations.

UNIT-IV

Mineral Resources of India: Geological time scale, ore forming process, Major and Minor mineral resources of India, Brief description of origin, environment and distribution of mineral deposits of India. Ore resource estimation.

UNIT-V

Mineral Exploration: Basics of Geological, Geophysical and Geochemical exploration of mineral deposits. Mineral Reserves: Estimation and determination of mineral reserves. Application of remote sensing and GIS in geological mapping and mineral exploration.

TEXT BOOKS:

1. Exploration and Mining Geology (2nd Ed.); 1987. John Wiley & Sons, New York.

REFERENCE BOOKS:

1. Mineral Resources of India, Krishna Swamy.
2. Mining Geology, Mc Kinstry.
3. Engineering Geology & Geotechnics, Krynine and Hudd.

FLUID MECHANICS AND HYDRAULIC MACHINES

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

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

1. To understand the basic principles of fluid mechanics
2. To identify various types of flows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

Course Outcomes:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts.

UNIT - I

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

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.

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

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, hydraulic design – 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.

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.

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.

Computational Mathematics Lab

(Using Python/MATLAB software)
(common For All Branches)
(II Year I Sem for Civil/Biotech/Pharma/CSE allied branches/Mech/Mining/Textile.)
(II Year II Sem for CSE/IT/EEE/ECE/EIE and other allied branches)

L	T	P	C
0	0	2	1

Pre-requisites: Matrices, Iterative methods and ordinary differential equations

Objectives:

To learn

12. Solve problems of Eigen values and Eigen Vectors using Python/MATLAB.
13. Solution of Algebraic and Transcendental Equations using Python/MATLAB
14. Solve problems of Linear system of equations
15. Solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

*** Visualize all solutions Graphically through programmes**

UNIT-I: Eigen values and Eigenvectors: **6P**

Programs:

- Finding real and complex Eigen values.
- Finding Eigen vectors.

UNIT-II: Solution of Algebraic and Transcendental Equations **6P**

Bisection method, Newton Raphson Method

Programs:

- Root of a given equation using Bisection method.
- Root of a given equation Newton Raphson Method.

UNIT-III: Linear system of equations: **6P**

Jacobi's iteration method and Gauss-Seidal iteration method

Programs:

- Solution of given system of linear equations using Jacobi'smethod
- Solution of given system of linear equations using Gauss-Seidal method

UNIT-IV: First-Order ODEs 8P

Exact and non exact equations, Applications: exponential growth/decay, Newton's law of cooling.

Programs:

- Solving exactand non-exactequations

- Solving exponential growth/decay and Newton's law of cooling problems

UNIT-V: Higher orderlinear differential equations with constant coefficients 6P

Programs:

- Solving homogeneous ODEs
- Solving non homogeneous ODEs

Course outcomes:

After learning the contents of this paper, the student must be able to

16. Develop the code to find the Eigen values and Eigen Vectors using Python/MATLAB.
17. Develop the code find solution of Algebraic and Transcendental Equations and Linear system of equations using Python/MATLAB
12. Write the code to solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

Text Books

1. MATLAB and its Applications in Engineering, Rajkumar Basal, Ashok Kumar Geo, Manoj Kumar Sharama, Pearson publication.
2. Kenneth A. Lambert, The fundamentals of Python: First Programs, 2011, Cengage Learnings.
3. Think Python First Edition, by Allen B. Downey, Orielly publishings.
4. Introduction to Python Programming, William Mitchell, Povel Solin, Martin Novak et al., NCLab Public Computing, 2012.
5. Introduction to Python Programming, ©Jacob Fredslund, 2007.

References

1. An Introduction to Python, John C. Lusth, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

MINE SURVEYING-I LABORATORY

B.Tech. II Year I Sem

L	T	P	C
0	0	2	1

Pre-Requisites: Mine Surveying
Course Objectives: To familiarize with the various surveying instruments and methods.
Course Outcomes: At the end of the course, students will be able to

1. Do the Range and to measure the distance between two points
2. Conduct the chain triangulation survey
3. Determine the area by using different methods
4. Determine the elevation of a given point
5. Use the instruments used in the surveying

LIST OF EXPERIMENTS:

1. Measurement of distance between three prints (A,B,C) using Chain (with and without obstacles)
2. Measurement of distance between three points (A,B,C) using Tapes. (with and without obstacles)
3. Setting out a right angle using offset surveying method.
4. Measurement of bearing angle between two or three points using prismatic compass.
5. Study of Dumpy level.
6. Fly Levelling.
7. Reciprocal levelling.
8. Computation of area. (ovend by three points. (A,B,C)
9. Computation of volume (ovend by three points. (A,B,C)
10. Two point method or three point method in plane table surveying.

MINING GEOLOGY LABORATORY

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Pre-Requisites: Mining Geology

Course Objectives: To identify minerals, rocks, ores and geological structures. To learn geological mapping, remote Sensing

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

1. Identify the properties of rock forming and ore forming minerals
2. Determine the strike and dip planar features by clinometer compass. Mine Surveying
3. Identify the folds, faults and unconformities
4. Knowledge of geology mapping
5. Determine the unconfined compressive strength of important rocks. g techniques and geophysical methods

LIST OF EXPERIMENTS:

1. Identification and physical properties of important rock-forming and ore-forming minerals.
2. Identification and distinguishing characteristics of important igneous, sedimentary and metamorphic rocks.
3. Determination of strike and dip of planar features using brunton compass.
4. Study of models pertaining to folds, faults and unconformities.
5. Study and interpretation of Topographic Maps.
6. Study of Geological Maps of Telangana, Andhra Pradesh & India.
7. Study of Geomorphologic Map of India and Tectonic Map of India.
8. Study of Seismotectonic Atlas of India.
9. Vertical Electrical Sounding Survey to determine depth to water table & bed rock.
10. Determination of strike and dip of the deposits.

FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Pre-Requisites: NIL

Course Objectives:

1. To understand the basic principles of fluid mechanics.
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes.
4. To evaluate the performance of hydraulic turbines.
5. To understand the functioning and characteristic curves of pumps.

Course Outcomes:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts

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.

SURFACE MINING TECHNOLOGY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

1. The objective of this course is to provide students in mining engineering with the necessary knowledge to design safe, efficient and environmentally responsible surface mining operations.
2. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

Course Outcome: The students will have ability to

1. classify and select the suitable surface mining methods and equipment based on site conditions.
2. Understand layouts and design of surface mines
3. Have a concept of waste dump formations and slope failures in surface mines
4. Learn about ground preparation methods and equipment used for ground preparation
5. Obtain knowledge about excavation systems and transportation systems and numerical problems.

UNIT - I

Introduction: Status of surface mining in India, 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.

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. Lift and lead calculation.

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.

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. Determining the capacity and number of shovels and dumpers for planned production. Scope and application of in-pit crushers in surface mines. Illumination in surface mines**.**

UNIT - V

Environmental impact due to mining activities and monitoring soil, air, water and noise vibrations, precautions mitigation measures.

Noise level calculations due to HEMM used in open cast mines.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. SME Mining Engg. Handbook Vol. I and II, Hartman, H.L. (Ed.), Society for Mining, Metallurgy, and Exploration, Inc., 3rd edition, 2011.
2. Surface Mining, Mishra G.B., Dhanbad Publishers, Dhanbad, 1990.
3. Surface Mining, Pfleider, E. P, 1st Edition, New York, 1968.
4. Open pit Mining Operations, Rzhevsky V., Mir Publications, 1971.
5. Heavy Earth Moving Machinery, Amitosh De, Lovely Prakashan, Dhanbad, 2000.
6. Open Pit Mine Planning & Design, Vol. 1, Fundamentals, Hustrulid, W. and Kuchta, M, Balkema, Rotterdam, 1998.
7. Slope Stability in Surface Mining, Hustrulid, W. A., Mccarter, M. K., And Van Zyl, D. J. A., Ed., Littleton, 2000.
8. Surface Mining Technology, Das, S.K., Lovely Prakashan, Dhanbad, 1994.

MINE VENTILATION

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

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

1. Understand origin, physical and chemical properties of mine gases and their physiological effects
2. Understand Heat, Humidity and Air flow in mines
3. Understand Principal types of mine fans, Series and parallel operation of mine fans
4. Understand Standards of ventilation and Air distribution
5. Understand Ventilation Planning and Network analysis.

UNIT - I

Mine Gases: Origin, occurrence, physical, chemical and physiological properties of mine gases, instruments used for spot detection of mine gases. Various damps, methane drainage techniques. Gas chromatography.

UNIT - II

Mine Climate and Control: Sources of heat and humidity in mines and their effects, instruments used for measurement of temperature, humidity, pressure and velocity. Heat stress indices, cooling power and method of improving cooling power.

UNIT - III

Natural Ventilation and Laws of Air flow: Natural ventilation, Factors effecting NVP, Direction of air flow, Derivation of NVP, Motive column, Atkinson law governing airflow in mine openings.

UNIT - IV

Mechanical Ventilation: Definition of Mechanical ventilation, Different types of fans and their characteristics, Operating point, Fan laws, installation. Ventilation appliances, economic size of roadways, determination of quantity and head requirements. Fan selection and evasee. Ventilation networks: simple and complex, solutions to simple ventilation network. Introduction to Hardy cross method for solving complex network. Introduction to ventilation software's.

UNIT - V

Ventilation Planning: Standards of ventilation, ascensional ventilation, descensional ventilation, ventilation planning for different mining methods: Bord and pillar, Longwall mining method and cut and fill, sub level caving and shrinkage stoping method.

TEXT/ REFERENCE BOOKS:

1. Mine Environment and Ventilation. Mishra GB. Oxford University Press, 1992.
2. Mine Ventilation and Air Conditioning. Hartman HL. Wiley Interscience publication, 1993.
3. Subsurface Ventilation and Environmental Engineering. Pherson Mc. Chapman and Hall Publication, London, 1993.
4. Mine Environment Engineering. Vutukuri VS. Trans Tech Publishers, 1986

MINE SURVEYING - II

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Mine surveying-I

Course Objectives:

1. To choose proper method of surveying for any surveying assignment.
2. To set out simple curve on surface and in underground.
3. To determine the distance and elevation of any point on the surface & in underground.
4. To find out magnitude of error in various surveying.

Course Outcomes:

At the end of the course student will be able to:-

1. Apply knowledge of surveying for understanding, formulating and solving surveying problems.
2. Identify, formulate, and solve engineering problems in setting out.
3. Use the techniques, skills and modern engineering tools necessary for minesurveying.
4. Identify, analyze and solve surveying problems.
5. Work effectively as an individual and as a member of multidisciplinary team

UNIT - I

TACHEOMETRY: Principles of Stadia Methods; Determination of constants; Theory of anallactic lens; Distance and elevation formulae Subtense and Tangential Methods; Reduction of stadia Notes; Beaman stadia bar; Auto-reduction Tacheometer.

UNIT - II

SETTING OUT AND CURVES: Setting out simple curves on surface and in underground; Elementary knowledge of compound and transition curves; joint boundary survey; Equalization of boundaries; Maintenance of direction and gradient of roadways i.e. marking and checking of center line and grade line, transfer of point from roof to floor and floor to roof.

UNIT - III

PLANS & SECTIONS: General requirements of mine plans; types of plans; Symbols used in mine plans; preparation of plans & sections; Plotting of traverse; Checking accuracy of old mine plans; Planimeter and its uses; Enlargement & reduction of plans. Mines Regulations concerning above topics.

UNIT - IV

TRIANGULATION & CORRELATION SURVEY: Principles forming network of triangles; Selection of sites of triangulation stations; Base andCheck base lines; Measurement and adjustment of angles by simple methods; Calculationof Co-ordinates. Methods of correlation of surface and underground surveys through adits, inclines, andshafts; Use of magnetic needle and Gyro theodolites; Different methods of Stope surveying land open pit surveying.

UNIT - V

ASTRONOMICAL SURVEY, PHOTOGRAPHIC SURVEYING & MODERN SURVEYING TECHNIQUES: Definitions of important terms; Determination of azimuth by astronomical observations. General Principles; Phototheodolite; Stereo photographic Surveying; Aerial Surveying -Field of application; Vertical and oblique photographs; Aerial photography; Preparation ofphotographical maps by simple methods; EDM equipment; Geodimeter, Tellurometer, Total Station, Distomat, Softwares. GPS and GIS basic principles, integration of Remote Sensing, GIS and laser scanning

TEXT BOOKS:

1. Surveying Vol. I by B.C. Punmia & Ashok Jain

2. Suverying Vol. II by B.C.Punmia & Ashok Jain
3. Surveying Vol. I by S.K.Duggal
4. Surveying Vol II by S.K.Duggal
5. Mine Surveying Vol I by Ghatak
6. Mine Surveying Vol II by Ghatak

REFERENCE BOOKS:

1. Metalliferous Mine Surveying : Frederick Winniberg
2. Surveying and levelling :Kanetkar and Deshpande

UNDERGROUND COAL MINING TECHNOLOGY

B.Tech. II Year II Sem

L	T	P	C
3	0	0	3

Course Objectives:

1. To study the development of panels and extraction of coal in Bord and Pillar method.
2. To study the Longwall advancing and retreating methods.
3. To study the various special methods of winning coal.
4. To study and update of the mine criteria as per various legislation of India.
5. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

Course Outcomes: The students will gain knowledge on the following:

1. Development and depillaring of coal by Bord and Pillar.
2. Longwall mining by advancing and retreating methods.
3. Extraction of thick seams by slice mining.
4. Methods of winning of coal seams which are liable to spontaneous leaching and coal lumps.
5. Extraction of coal seams by blasting gallery methods, underground coal gasification and horizon mining.

UNIT - I

Introduction: Status of coal industry and deposit, estimation and classification coal reserves, Mode of entry by incline, shaft and adit; their application, advantages and disadvantages, 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, development of panel with semi mechanized equipment like LHD, SDL, Gathering Arm Loader with shuttle car and continuous miner.

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 and face arrangements for stowing. Partial extraction.

UNIT- IV

Longwall Method: Longwall advancing and retreating methods, development of panel, extraction of coal longwall mining with different machines-plough and shearer, design of longwall workings-optimum length of face, size of panel, gates, support system, personnel, organisation and safety measures, salvaging and relocations of equipment.

UNIT- V

Special Methods of Working: Problems of working thick & thin seams, Sublevel caving, Horizon mining, blasting gallery method, working of contiguous seams, working steeply inclined seams, working under surface structures and seams liable to spontaneous heating, outburst and bumps, etc. Hydraulic mining, Wongawalli mining method, shortwall, underground coal gasification, coal bed methane, shield mining; Thick seam mining methods- slice mining methods- Inclined slice mining with mechanized longwall mining.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Underground Winning of Coal – Singh, T.N. Singh, Oxford & IBH Publishing Co. Ltd.,1992.
2. Coal Mining in India, Mathur, S.P., M.S. Enterprises, Bilaspur, 1999.
3. Modern Coal Mining Technology Das S.K., Lovely Prakashan, Dhanbad 1994.
4. Thick Seam Mining, Problems and Issues, Singh T.N., Dhar, B.B. Oxford & IBH Publishers, 1992.
5. Mining Planning for Coal., Mathur, S.P., M.G. Consultants, Bilaspur, 1993.
6. Underground Mining Methods and Technology, Szwilski and Richards M.J., 1987.
7. Internet: www.miningindia.com.

MINE MECHANIZATION – I

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To extract and transport the minerals to the required processing unit/ utilization point variety of machines are 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: After going through this course,

1. The student will have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery.
2. Different types of rope haulages, mine locomotives, conveyors, laying of rail tracks for rope haulages and locomotives.
3. In addition, gains knowledge of the prime movers for the machinery and power transmission mechanisms.
4. Acquires knowledge of different types of conveyors and able to perform capacity calculations
5. Know about compressed air applications in mines.

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 locomotives.

Conveyors: Belt Conveyors and Chain Conveyors- Types, their installation, operation, shifting, maintenance, applicability and limitations. Vibration and shaking conveyers 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 conveyors.

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.

MINE SURVEYING-II LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	1.5

Pre-Requisites: Mine surveying-II

Course objectives:

1. To choose proper method of surveying for any surveying assignment.
2. To set out simple curve on surface and in underground.
3. To determine the distance and elevation of any point on the surface & in underground.
4. To find out magnitude of error in various surveying.

LIST OF EXPERIMENTS

1. Measurement of height of accessible and inaccessible point by trigonometric surveying.
2. Determination of stadia constant.
3. Distance and elevation determination by tachometric surveying.
4. Setting out of circular curve by chord and offset method.
5. Setting out of circular curve by Rankine's method.
6. Study of planimeter.
7. Study of Pantagraph / Eidograph.
8. Baseline measurement
9. Baseline extension
10. To connect the baseline to main triangulation network
11. Reduction to centre
12. Angle adjustments in triangulation network
13. Plotting the survey by co-ordinate methods
14. Correlation survey by Weisbach triangle method
15. Study of EDM
16. Study of Total station

MINE VENTILATION LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	1.5

Pre-Requisites: Mine Ventilation

Course Objective: To determine the psychrometric properties, gas percentage in atmosphere. To study the principles and characteristics governing mine fans. To understand lamp design and perform underground illumination surveys. To understand the temporary and permanent stoppings, preventive measures for mine explosions and rescue apparatus.

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

1. Determine the psychrometric properties, gas percentage in atmosphere.
2. Determine the relative humidity by hygrometer.
3. Knowledge of principles and characteristics governing mine fans.
4. Analyses ventilation network circuit.
5. Knowledge of mine air-conditions plant.

LIST OF EXPERIMENTS

1. Detection of mine gases
2. Orsat/Haldane apparatus for gas analysis.
3. Measurement of relative humidity by hygrometer.
4. Kata thermometer.
5. Constructional features of centrifugal and axial flow fans.
6. Characteristic curves for fans.
7. Operation of fans in series and parallel.
8. Design of various ventilation devices, Airshaft, Evasese, Doors crossing regulators.
9. Reversal of Ventilation system.
10. Measurement of air quantity by anemometer velometer and smoke tube, pressure survey.
11. Measurement of relative humidity by hygrometer.
12. Study and analysis ventilation network circuit.
13. Study of mine air-conditioning plant.
14. Study of Constructional features of a flame safety lamp and cap lamp, accumulation and percentage

MINE MECHANIZATION- I LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Pre-Requisites: NIL

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

1. Determine the angle of friction and coefficient of friction.
2. Explain the working of screw jack, calculate efficiency and constructional features of engine models
3. Evaluate the properties of different mining machinery components
4. Perform test on reciprocating air compressor
5. Study the characteristics of different machinery components.

LIST OF EXPERIMENTS

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. To study the dynamics of governor.

INTRODUCTION TO DATA SCIENCE FOR MINING ENGINEERING

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To introduce the fundamentals of data science and its relevance in the mining industry.
2. To develop skills in data handling, exploratory data analysis, and basic statistical methods using Python.
3. To enable students to apply machine learning techniques to solve problems in mineral exploration, mine planning, and safety analysis.

Course Outcomes:

1. By the end of the course, the student will be able to:
2. Understand the key concepts of data science and its applications in the mining domain.
3. Perform data wrangling, visualization, and basic analytics using Python libraries like Pandas, NumPy, and Matplotlib.
4. Apply simple machine learning techniques for predictive analysis in mining scenarios such as equipment failure, safety incidents, and resource estimation.

Lab Experiments

1. Introduction to Python & Jupyter Notebooks
2. Working with NumPy for Numerical Operations
3. Reading and Writing Data using Pandas
4. Data Cleaning and Preprocessing
5. Data Visualization using Matplotlib and Seaborn
6. Descriptive Stati stics and Correlation
7. Exploratory Data Analysis (EDA) on Mining Dataset
8. Simple Linear Regression for Resource Prediction
9. Classification using KNN or Decision Trees
10. Mini Project – Predicting Equipment Failure

Reference Books:

1. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media.
2. Jake VanerPlas, Python Data Science Handbook, O'Reilly Media.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.
4. Chirag Shah, A Hands-On Introduction to Data Science, Cambridge University Press.
5. Debabrata Samanta, Data Science and Analytics with Python, Wiley India.

ROCK MECHANICS

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

1. To study and understand various aspects of rock mechanics and its application to mining.
2. Introducing the various instrumentation and measurement methods.
3. To study the theories of failure and approaches used for open pit and underground designs.
4. To Understand various aspects of supports and their design for various situations.
5. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

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

1. Understand important terms used in rock mechanics, application of rock mechanics in mining, introduction to stress analysis
2. Understand Physical properties of rocks and rock indices.
3. Understand Mechanical properties of rocks
4. Understand Non-destructive testing methods and time dependent properties of rocks
5. Understand Theories of failure of rocks & Design of underground workings.

UNIT - I

Physical properties: Density, porosity, void ratio, moisture content, permeability. Mechanical Properties: Preparation of rock samples, determination of mechanical properties of rocks: compressive strength, tensile strength, shear strength, modulus of elasticity, poisson's ratio, cohesion, angle of internal friction, Protodyaknov`s strength index, longitudinal wave velocity, rock burst ability index, Schmidt rebound hardness number, slake durability index.

UNIT - II

Rock mass classification: Core recovery, Rock quality designation, Rock mass rating, Indian- geo mechanics classification, Q System, Geological strength index, Slope mass rating, rippability classification, Coal mine roof rating.

UNIT - III

Stress strain analysis: Analysis of stress and strain in two and three dimensions, Principal stress, stress ellipsoid, Determination of principal stress and strain invariants; Differential equilibrium equations; compatibility equation of stress and strains, Stress and strain transformation, Mohr's circle of stress and strain, Plane stress and plane strain condition.

UNIT - IV

Rock mass behavior: Confining pressures, effect of water, time, temperature. Insitu stress and their estimation; flat jack method, over coring method and hydro fracturing method; Horizontal and vertical stress, intact rock strength and deformability; measuring devices for load, stress and strain. Dynamic loading of rocks Time dependent properties of rock, creep, mechanism of creep of rocks – different stages, rheological models

UNIT - V

Rock failure theories: Coulomb, Mohr's – Coulomb, Hoek and Brown, Griffiths and Drucker – Prager and Its related calculations

TEXT / REFERENCE BOOKS:

1. Fundamental and application of rock mechanics, Deb D and Verma AK,. PHI publication
2. Finite elemnt method: concepts and application in geo mechanics, Debasis Deb.
3. Theory of Elasticity, SP Timoshenko, JN. Goodier.

4. Rock Mechanics and ground control, V Singh and B P Khare.
5. Rock Mechanics and design of structures in rock, Obert and Duvall.
6. Rock Mechanics, Jumikis.
7. Introduction to Rock Mechanics, Goodman.
8. Engineering rock mass classification, Binawiski ZT.
9. Rock mass classification, Singh & goel.

MINE MECHANIZATION - II

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

Course Outcomes: After going through this course the student will

1. Have the basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery.
2. Gain information on Different types of mine winders such as koepe and drum winders.
3. Understand constructional feature and applications of man riding systems in underground mines and about different types of cutter loaders
4. Acquire knowledge of different types of face machinery like SDL, LHD, Continuous miners, mine pumps etc., used in mechanised and semi-mechanised mines.
5. Know about open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc., and their capacity calculations.

UNIT - I

Mine Winders: Koepe and Drum winders and their applications, head gear, 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 only. Pit top railway ridings.

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 Jack hammer.

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, Bucket Wheel Excavator, Surface Miners. – their basic construction, applications and operation.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MINE HAZARDS AND RESCUE

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

Course Outcomes: After going through this course, the student will

1. have knowledge about different Rescue apparatus and their applications.
2. Gain knowledge on assessment and control of hazard due to mine fires, inundations, mine dust etc.,
3. Learn about Operation and maintenance of different firefighting equipment and preventive measures for different mine hazards.
4. Know about dealing with waterlogged bodies and designing dams and sumps.
5. Acquires knowledge on handling of flame safety lamp and illumination standards for opencast and underground workings.

UNIT - I

Mine fires: Classification, surface and underground fires, causes and effect of mine fires, spontaneous combustion, causes and nature of spontaneous combustion, its detection and prevention. Firefighting equipment: selection, installation, operation and maintenance in mines. Rescue brigade, sealing of fire areas, re-opening of sealed off areas.

UNIT - II

Explosions: Classification of explosions, causes of underground explosions, Fire damp explosions: causes and preventive measures, Coal dust explosions, Concept of Coward Diagram, Explosibilty of coal dust, causes and preventive measures to be taken against coal dust explosions, water gas explosion.

UNIT - III

Inundation: Causes of mine inundations from surface and underground sources, precautionary and productive measures on surface and in underground, Approaching water logged areas and dewatering of water logged areas. Design of various water dams, sump and pumps.

UNIT - IV

Rescue and recovery work: Mine rescue and first aid equipment, short distance apparatus, self-contained oxygen breathing apparatus, self-rescuers, reviving apparatus, rescue stations, organization, rescue and recovery work in connection with fires, explosions and inundations. Basic principles of risk management. Dust in mine air: dust production in mines and its control, health hazards, sampling and assessment of airborne dust.

UNIT - V

Mine illumination: Standards of illumination, common types of flame safety lamps, their use and limitations, electric hand and cap lamp, their maintenance and examination, lamp room design and organization. Illumination arrangements of opencast and underground workings as per DGMS standards.

TEXT / REFERENCE BOOKS:

1. Mine Fires explosions, rescue, recovery and illuminations, Ramulu MA.
2. Fires in coal mines, Kaku.
3. Elements of Mining Technology, Vol.-I, DJ Deshmukh.

DRILLING AND BLASTING

(Professional Elective –I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: To familiarize the students

1. With exploratory and production drilling.
2. The factors affecting drilling;
3. Various types of the explosives and blasting techniques used in underground.
4. Transportation and handling of explosives in opencast mines; use of accessories for blasting in opencast mines.
5. Controlled blasting and use of computers and software for blasting in open cast mining.

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

1. Gain knowledge about exploratory/diamond drilling, use of fishing tools.
2. Understands various methods of drilling, design and selection of drilling methods under or for different conditions.
3. Knowledge about explosives and blasting techniques in underground mines and open cast mines.
4. Makes student confident in design of blasting operations in the field.
5. Learn about controlled blasting, use of softwares in rock blasting.

UNIT - I

Exploratory Drilling: Drilling for exploration and other purposes; diamond drilling-equipment and principal of operation, its 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 of 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: Drillability studie**s,** Factors affecting drilling- operational parameters (like air pressure, thrust, r.p.m., flushing, bit type and bit geometry) 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.

UNIT - III

Explosives: Classification and properties of explosives, Types of explosives – Permitted type and their importance, slurry explosives, SMS, SME and PMS, ANFO, Emulsion, boosters. Mechanics of blasting.

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

UNIT - IV

Open Pit Blasting: Blasting in opencast mines, rock breakage mechanism, blast design, factors influencing blast design and blast optimization, primary and secondary blasting; environmental impacts due to blasting-ground vibrations, air over pressures, fly rocks, dust, fumes, water pollution;
controlled blasting, computer design of opencast blast; statutory requirements. Introduction to different blasting and fragmentation analysis softwares.

UNIT - V

Underground Blasting: Drill patterns for underground excavations, solid blasting; VCR 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.

TEXT BOOKS:

1. Blasting in ground excavations and mines, Roy Piyush Pal, Oxford and IBH, 1st ed 1993.
2. Drilling technology handbook, C.P. Chugh, Oxford and IBH, 1sted, 1977.
3. Explosives and Blasting Techniques by G.K. Pradhan

REFERENCE BOOKS:

1. Rock blasting effect and operation, Roy Piush Pal, A.A. Balkema, 1st ed, 2005.
2. Elements of mining technology, Vol-1, D.J. Deshmukh, Central techno, 7th ed, 2001.
3. Blasting operations, B. Hemphill Gary, Mc-Graw Hill, 1st ed 1981.
4. Principles and practices of modern coal mining, R.D. Singh, New age International, 1st ed, 1977.
5. Explosive and blasting practices in mines, S.K. Das, Lovely prakashan, 1st ed, 1993.

NPTEL : Drilling and Blasting Technology by Prof. Kaushik Dey, IIT Kharaghpur

ADVANCED SURFACE MINING
(Professional Elective – I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Surface Mining Technology

Course Objectives:

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

Course Outcomes: The students will be able to

1. Have insight about the advanced techniques for surface mine planning and production scheduling.
2. Able to perform geotechnical investigation on parameters influencing slope stability and influence of pit slope on mine economics
3. Understand production and equipment planning and management.
4. Get knowledge on occupational health hazards due to mine dust and mine environment
5. Know about the modern trends in opencast 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(2D&3D), and computer assisted hand method. Addition of haul road 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

Rock slope Engineering, 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.

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.

UNIT - IV

Health, Safety and Environmental Management: Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Accidents in Surface mining and their prevention; 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 surface mines.

TEXT BOOKS

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

REFERENCE BOOKS

1. Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995.
2. Surface Mining Technology, Das, S.K., Lovely Prakashan, Dhanbad, 1994.
3. Modern Coal Mining Technology, Das, S.K., Lovely Prakashan, Dhanbad, 1994.
4. Surface Mining – 2nd Edition, SME, Kennedy, B.A., New York, 1990.

NPTEL : Surface Mining Technology by Prof. Kaushik Dey, IIT Karghpur.

MATERIAL MANAGEMENT IN MINES
(Professional Elective - I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Outcomes: Students will

1. Gain Knowledge on importance of material management and different methods.
2. Understand material planning and purchase system.
3. understand store accounting, stock verification and value analysis.
4. Gain knowledge in inventory management.
5. Get to know about rules, regulations and acts of material management.

UNIT – I:
Introduction: Introduction to material management, importance of integrated materials management, need for integrated materials management concept, definition, scope and advantage – an overview, A-B-C analysis, codification, variety reduction, standardisation.

UNIT – II:
Purchasing Management: Material planning and purchase, purchase system, procedures, price forecasting, purchasing of capital equipment, vendor development, account procedure, purchasing decisions, procurement policies.

UNIT – III:
Warehousing and Store Management: Store keeping principles – past and latest techniques, stores – general layout, cost aspect and productivity, problems and development, store system procedures, incoming material control, store accounting and stock incoming material control, store accounting and stock verification, value analysis.

UNIT – IV:
Inventory Management: Introduction, basic models, definitions of commonly used terms, replenishment model, choice of systems, etc., inventory work in progress, safety stock, computerisation in materials management, control, information to materials management case study, spare parts management.

UNIT – V:
Material Procurement Procedures: Arbitration Act – Octroi, central and local sales tax, excise duties – customs tariff, import control policies, procurement from govt, agencies and international market - insurance, DGS and D tariff.

TEXT BOOKS / REFERENCE BOOKS:

1. Material Management: An Integrated Approach, Goplakrishnan, P, and Sundaresan, M. Prentice Hall of India Pvt Ltd., New Delhi, 1982.
2. Materials Management procedure, Test and cases, Datta, A.K., Prentice Hall of India Pvt Ltd., New Delhi 1984.
3. Effective Materials Management, Peckam, H.H., prentice Hall of India Pvt Ltd., 1984.
4. Modern Inventory Management, Prichard, J.W., and Eagle, R.H. N, Y., Wiley and Breach Science Publishers, 1972.

INTRODUCTION TO MINING TECHNOLOGY
(Open Elective - I)

B.Tech. III Year I Sem.

L	T	P	C
2	0	0	2

Pre-Requisites: NIL

Course Objectives: The student is expected to learn the fundamentals of mining engineering so as to encourage multi-disciplinary research and application of other branches of engineering to mining technology.

Course Outcomes: Upon completion of the course, the student shall be able

1. To acquire the knowledge of formation and distributions of mineral deposits.
2. To get exposure of different stages of mining operation.
3. Obtain the knowledge of various mining methods adopted for extraction of mineral deposits.
4. Understand the various drilling techniques and explosives being practiced in mines
5. Learn about different types of access making techniques to mineral deposits.

UNIT-I
Introduction: Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology,

UNIT-II
Stages in the life of the mine - prospecting, exploration, development, exploitation and reclamation. Access to mineral deposit- selection, location, size and shape (incline, shaft and adit), brief overview of underground and surface mining methods.

UNIT-III
Drilling: Types of drills, drilling methods, electric, pneumatic and hydraulic drills, drill steels and bits, drilling rigs, and jumbos.

UNIT-IV
Explosives: Classification, composition, properties and tests, fuses, detonators, blasting devices and accessories, substitutes for explosives, handling and storage, transportation of explosives.; Rock blasting: Mechanism of rock blasting, blasting procedure, and pattern of shot holes.

UNIT-V
Shaft sinking: Ordinary and special methods, problems, and precautions, shaft supports and lining.

TEXT BOOKS:

1. Rock blasting effect and operation, R. P. Pal, A. A. Balkema, 1st Ed, 2005.
2. Elements of mining technology, Vol. 1, D. J. Deshmukh, Central techno, 7th Ed, 2001.

REFERENCE BOOKS:

1. Drilling technology handbook, C. P. Chugh, Oxford and IBH, 1st Ed, 1977.
2. Principles and practices of modern coal mining, R. D. Singh, New age international, 1st Ed, 1997.

UNDERGROUND COAL GASIFICATION
(Open Elective - I)

B.Tech. III Year I Sem.

L	T	P	C
2	0	0	2

Pre-Requisites: NIL

Course Objectives: To specialize the students with additional knowledge on geological and technological factors of coal gasification industry mining methods of underground coal gasification, linkage techniques etc.

Course Outcomes:

1. Student can get specialized in the Underground Coal Gasification (UCG) concepts, application and future scope in various geo-mining conditions.
2. Student will learn about underground coal gasification process component factors and able to understand opening of coal seams to implement UCG method.
3. Student will learn about various mining methods of UCG.
4. Student will learn about various non-mining methods of UCG.
5. Student will learn about various linkage techniques during development of UCG.

UNIT - I

Underground Coal Gasification (UCG) Concept; Chemistry, conditions suitable for UCG, Principles of UCG., Merits and Demerits.

UNIT - II

UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG.

UNIT - III

Mining methods of UCG: Chamber method, Stream method, Borehole procedure method, Blind bore hole method.

UNIT - IV

Non-Mining methods of UCG: Level seams, Inclined seams.

UNIT - V

Linkage Techniques: Percolation linkage, Electro linkage, Boring linkage, compressed-air-linkage, Hydraulic fracture linkage. Future Scope and Development: Innovations.

TEXT BOOKS:

1. Underground Coal Mining Methods – J.G. SINGH
2. Winning and Working Coal in India Vol. II- R.T. Deshmukh and D.J. Deshmukh.

REFERENCE BOOK:

1. Principles and Practices of Modern Coal Mining – R.D. SINGH.

ROCK MECHANICS LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	3	1.5

Pre-Requisites: NIL

Course objectives:

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

Course outcomes:

1. The students will have knowledge on strength and deformation characteristics of rock using different methods.
2. The students will able to perform test to determine the porosity of rocks
3. The students will able to understand weatherability of rocks through slake durability test
4. The students will acquire knowledge on drilability of rocks
5. The students will able to use different types of roof monitoring devices.

LIST OF EXPERIMENTS

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.

MINE MECHANIZATION - II LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	3	1.5

Pre-Requisites: NIL

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: After this course, students will able to

1. Describe the constructional details of various mining equipment.
2. Explain the working of mining machinery.
3. Develop different hydraulic circuits and perform investigations of hydrostatic transmission
4. Develop different types of pneumatic circuits and acquire details of jack hammer drill
5. Study about the details of different types of pumps used in mines and determine fatigue strength and breaking strength of steel wires

LIST OF EXPERIMENTS

1. Study of gate end box
2. Study of drill panel and handheld in a drill
3. Study of mining type electric cable.
4. Study of pillar switch
5. To develop different hydraulic circuits in hydraulic trainer.
6. To study the construction and operation of hydraulic pumps, motors and valves
7. To study the construction and operation of hydraulic fittings and hoses.
8. Performance investigation of hydrostatic transmission systems with different motors.
9. To develop different pneumatic logic circuits in pneumatic trainer
10. Performance test of centrifugal pumps
11. Performance test on reciprocating pump
12. Dismantling and assembly of Jack Hammer Drill machines
13. Determination of fatigue strength of steel wires
14. Determination of Breaking strength of steel wire ropes

MINE HAZARDS AND RESCUE LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	2	1

Pre-Requisites: NIL

Course outcomes:

1. The students will have knowledge on different types of breathing apparatus.
2. The students will able to perform test to determine the flammability temperature, noise level and illumination.
3. The students will able to understand construction and working of explosion proof fire stopping
4. The students will acquire knowledge on usage of soil test kit and dust samplers.

LIST OF EXPERIMENTS

1. Study of MSA type gas mask i) Filter type apparatus ii) Self Rescue.
2. Study of self-contained breathing apparatus i) Drager BG-174 ii) By Travox -120
3. Study of Drager pulmotor
4. Estimation of SPM concentration in air using high volume sampler.
5. Study of construction and working of explosion proof fire stopping.
6. Determination of flammability temperature of coal.
7. Determination of nutrient status in soil using soil test kit.
8. Measurement of Noise level by integrated sound level meter.
9. Measurement of Lux by light meter.
10. Air borne dust modeling.
11. Stone dust and water barriers.

ENVIRONMENTAL MANAGEMENT IN MINING LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives: The course aims to:

1. Develop practical skills for monitoring, assessing, and mitigating environmental impacts of mining activities.
2. Provide hands-on experience in water, air, noise, and soil quality assessment in mining contexts.
3. Equip students with the ability to conduct acid mine drainage (AMD) detection and remediation trials.
4. Introduce students to environmental instrumentation, sampling protocols, and laboratory analysis techniques.

Experiments:

1. **Water Quality Analysis of Mine Discharge:** Test mine effluent for pH, TDS, turbidity, conductivity, and selected heavy metals (Fe, Cu, Pb)
2. **Acid Mine Drainage (AMD) Screening Test & Neutralization Trial:** Detect AMD potential and evaluate lime dosing for neutralization.
3. **Tailings Characterization: Grain Size & Settling Behavior:** Determine particle-size distribution and settling rates of tailing slurry.
4. **Design Exercise — Small-Scale Tailings Thickener Test:** Use lab settling data to estimate thickener area and underflow concentration.
5. **Leachability Test (TCLP or Simple Batch Leach Test):** Assess potential for contaminant leaching from mine waste/tailings.
6. **Soil Toxicity & Phytotoxicity Bioassay:** Evaluate contaminated mine soil's effect on seed germination and plant growth.
7. **Noise Level Survey & Mitigation Assessment:** Measure noise at mine equipment/plant locations and evaluate control options.
8. **Air Quality Monitoring — Dust Sampling & PM Analysis:** Collect respirable and total dust samples and perform gravimetric analysis for PM_{10}/$PM_{2.5}$ (or simple dust deposition).
9. **Groundwater Vulnerability Mapping (Mini GIS Exercise):** Map potential contamination pathways from mine site to groundwater using basic GIS layers.
10. **Noise & Vibration Prediction from Blasting (Field/Lab Simulation):** Estimate blast-induced vibration and overpressure and compare with thresholds
11. **Tailings Dam Stability Concept Test (Physical Model) :** Demonstrate slope stability and seepage effects on a small-scale tailings dam model.
12. **Reclamation & Phytoremediation Pot Trial :** Test native/selected plant species for revegetation potential on mine spoil and assess soil amendment effects.

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

1. Perform field sampling and laboratory testing for mine water, air, and soil quality parameters.
2. Identify, quantify, and propose solutions for environmental issues such as AMD, dust generation, and noise pollution in mines.
3. Operate environmental monitoring instruments such as pH meters, gas detectors, sound level meters, dust samplers, and GPS/GIS tools.
4. Conduct small-scale experiments to simulate tailings dam behaviour, sedimentation, and waste stabilization.
5. Interpret environmental data and compare results with statutory limits and international best practices.

MINE PLANNING & DESIGN

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

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

Course Outcomes: The students will

1. Have knowledge on planning of opencast mining, underground mining and equipment utilization.
2. Learn about initial designs, sequence of designs and various methods used to design ultimate pit configuration.
3. Able to perform capacity calculations, design mine entries, manpower management and calculate productivity indices.
4. Understand about planning and selection of appropriate machinery and able to perform their capacity calculations.
5. Acquire knowledge about project implementation and monitoring and about time management, scheduling etc.

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 and underground mining.

UNIT - II

Opencast Mining: 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; Development of Ultimate Pit Configuration (open pit limits) and its determination – hand method, floating cone technique(2D&3D), Lerchs-Grossmann algorithm and computer assisted hand method; 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, 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 length of faces, 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: 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Mining Modelling, Ehrenburger, V and Fajkos, A., Elsevier, 1995.
2. Innovative Mine Design for the 21st Century Elsevier, Bawden, W.F., and Archibald., J.F., 1993.
3. Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy, and Exploration, Christoper J. Bise, 2003.
4. Design of Underground Hard Coal Mines, Pazdziora, J., Elsevier, 1988.
5. Underground Hard Coal Mines, Swilski, and Richards, Elsevier, 1986.
6. Blasting in Underground excavations and mines, Singh, B. and Pal Roy, P., CMRS Dhanbad, 1993.
7. Longwall Mining, Peng, S.S. and Chaing, H.S., John Wiley & Sons, New York, 1984.
8. Opencast Mining – Technology and Integrated Mechanisation, Rzhevsky, V.V., MIR Publishers, Moscow, 1987.
9. Opencast Mining – Unit Operations, Rzhevsky, V.V., MIR Publishers, Moscow, 1987.

MINERAL PROCESSING

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: This course enables the students to choose suitable parameters and appropriate methodology & machinery for processing various types of minerals.

Course Outcome: At the end of this course:

1. The students will have knowledge on importance of mineral processing and treatment of ore & minerals.
2. The students will have knowledge on processing of minerals / ores / coal
3. The student will acquire knowledge on different types of crushers and grinding mills.
4. Gain knowledge on various types of sampling and concentration techniques.
5. In addition, gains knowledge on special methods of ore treatment and their flow sheets.

UNIT - I

Introduction: Scope, objectives, minerals/ores for mineral processing, methods of treatment, choice of methods, sequence of operations, product, flow sheets, ore sorting – hand / mechanical, electronic, removal of harmful materials, ore transportation.

UNIT - II

Comminution: Introduction to comminution, reduction ratio, primary/secondary/tertiary crushing, purpose, theory of crushing, types of crushers and comparison, general crushing and grinding flow sheet, wet/dry grinding, mechanism and various affecting parameters. Power consumption for crushing & grinding.

UNIT - III

Laboratory & Industrial Sizing and Sampling: Comparisons of different sampling techniques. Collecting sample on site (mine face); Purpose, factors governing particle behaviour - Sampling and weighing the ore, moisture and assay value, on stream analysis, automatic control in mineral processing, laboratory and industrial screens, trommels, vibrating screens, etc. wet and dry screening, classification, classifiers.

UNIT - IV

Separation/Concentration: Newton's and Stoke's Laws of particle settlement, different sampling techniques and their comparison, different concentration techniques – gravity, chemical froth flotation, wet & dry magnetic separation, electromagnetic, amalgamation, heavy media separation (Hons)& DMS, jigging, shaking tables, sluicing, spirals, thickeners, filtration, etc., Colour based sorting of minerals – optical sorter; Coal washing. Applications and limitations, electrical methods of concentration.

UNIT - V

Special Methods: Chemical extraction, cyanide process, leaching, use of ion exchange, solvent extraction, pilot plant studies on ores, tailing dams – mode of disposal, construction and design & other solid-waste (other than overburden) management in mines; generalised plant practice/flow sheets for coal and other important ores – copper, aluminum, lead, zinc, gold, uranium, iron, limestone, magnesite and beach sand minerals.

TEXT BOOKS:

1. Mineral Processing Technology, Wills, B.A, Pergamon Press, Oxford, 2006.
2. Ore Dressing, Jain, S.K, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1986.
3. Textbook of Mineral Processing, DV Subba Rao, - Scientific publishers 2017

REFERENCE BOOKS:

1. Principles of Mineral Dressing, Gaudin, A. M, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 2003.
2. Principles of Mineral Processing, Society for Mining, Metallurgy, and Exploration, Maurice C. Fuerstenau (Editor), Kenneth N. Han (Editor), 573 p, 2003.
3. Mineral Processing, 3rd Edition Prayor, E.J, (1974), Applied Science Publishers, London, p. 844.
4. Textbook of Ore Dressing, Richards, R. H, Charles E. Locke, S.B and Schuhmann, R, (1953), McGraw-Hill Book Company Inc, New York, p. 608.
5. Handbook of Mineral Dressing, Taggert, A. F, Chapman and Hall, New York, 1945.
6. Handbook on Mineral Dressing, Vijayendra, H. G, Vikas Publishing House Pvt. Ltd., New Delhi, 2001.
7. Mineral Processing Handbook, Volume – I &II, Weiss, N.L. (Ed.), S.M.E. 1986.

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

L	T	P	C
3	0	0	3

B. Tech. III Year II SEM

Course Objectives:

- Familiarize the fundamental principles, functions, and evolving approaches of management in organizational settings.
- Discuss the processes of planning, decision making, and problem solving, emphasizing creativity and innovation.
- Analyze organizational structures, HR practices, and strategies for effective people management and organizational development.
- Evaluate leadership styles, motivational theories, and techniques for engaging and empowering employees and teams.
- Apply control mechanisms and contemporary management concepts such as Diversity & Inclusion, ESG, and Sustainable Development Goals in managerial practice.

Course Outcomes:

- Understand the nature, scope, and functions of management, and compare classical and modern management approaches. (SDG – 9)
- Illustrate and develop plans and decision-making frameworks to address organizational challenges creatively and systematically. (SDG – 9, 16)
- Analyze and design organizational structures and HR strategies including recruitment, training, and performance management for organizational effectiveness. (SDG – 8)
- Evaluate and differentiate leadership styles and motivational techniques to improve team performance and handle crises effectively. (SDG – 3, 11)
- Apply and Integrate control processes and contemporary management practices that promote sustainability, inclusion, and ethical governance. (SDG – 8, 9)

Unit- 1: 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 – 2: Planning and Decision Making:

General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Production Planning and Control. Decision making and Problem Solving – Types of 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- 3: 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: Job Satisfaction, Job Enrichment, Job Enlargement, Talent Management, Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

Unit- 4: 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- 5: 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.
Contemporary concepts in Management like Diversity & Inclusion, Environmental Social Governance (ESG), Sustainable Development Goals (SDG) goals.

Suggested Readings:

1. Fundamentals of Management, Stephen P.Robbins, Mary Coutler, David D Cenzo, 9E, Pearson Education, 2023.
2. Management Fundamentals Concepts, Applications, and Skill Development, Robert N Lussier, 10e, Sage Publications, 2023.
3. Harold Koontz, Heinz Weihrich, Mark V. Cannice, Essentials of management, 11e, Mc Graw Hill, 2020.
4. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
5. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.

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COMPUTER APPLICATIONS IN MINING
(Professional Elective - II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL.

Course Objectives:

1. To impart knowledge on hardware and software issues concerned with computers in mining industry.
2. To develop algorithms and programs on various mining related problems
3. To impart knowledge on high-end simulation methodologies
4. To study modern techniques on solving mining problems.

Course Outcome: The students will have

1. Basic programming knowledge and its applications on various mining related applications.
2. Familiarity with hardware and software issues during development of programs.
3. Knowledge on stability analysis and ventilation network analysis in coal and metal mines
4. A perspective on high-end simulation methodologies and modern techniques to solve mining problems.

UNIT - I

Introduction to computers : Configuration of computers and servers, algorithm, flow charts and Programming of mining application like pillar design, blast design, subsidence.

UNIT - II

Design of the mine entries such as Incline, Shaft, Decline and Adit. Stability analysis and design of coal pillars, coal panels, stope pillars and barriers.

UNIT - III

Subsidence prediction: Longwall, Continuous miner, Board and Pillar, Cut & Fill method and Shrinkage stoping. Stability analysis and design of high walls, production fronts, dumps of opencast coal mine and metal mines.

UNIT - IV

Development of ventilation network for Bord & Pillar, longwall, Continuous miner in coal and metal mine methods. Network analysis for the emerging mining methods. Design of the mine fan capacity.

UNIT – V

Introduction to mine softwares: Data mine, Surpac, flac etc. applications of AI, ML neural networks in mining, fragment analysis software case studies.

TEXT BOOKS:

1. Computer Applications in the Minerals Industries, Kadri Dagdelen, Editor, Colorado School of Mines, 1999.
2. Computers in Mineral Industry, Ramani R.V., et al. Oxford and IBH Publishers, 1994.

REFERENCE BOOKS:

1. APCOM Proceedings Application of Computers and Operations, R. V. Ramani – Editor, Research in the Mineral Industry, The Society of Mining, Metallurgy and Exploration, Inc., 1996.
2. Computers Applications in Mineral Industry, Fytas, K. and Singhal, R. K. A. A. Balkema Publication, 1988.

3. Fundamentals of Computers, E Balagurusamy, Mc Graw Hills Publication, 2009.
4. Computers Today Fourth Edition, Basandra S K, Galgotia Publications Pvt. Ltd, 2004.

DIMENSIONAL STONE TECHNOLOGY
(Professional Elective – II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: To familiarize students with the resources of dimensional stone in India & abroad and basic concept of mining techniques for all types of dimensional stones, processing techniques, multiwire technology and study about environmental impact in surrounding.

Course Outcomes: Dimensional Stone Technology is important to get idea to excavate blocks of marble, granite, sandstone etc.

1. Students will get an idea of resources for dimension stones and Indian dimension stone mining trend.
2. Understand the criteria for selection of dimension stone deposit and procedure of obtaining statutory permissions
3. Students get a benefit of detailed understanding of various techniques of dimensional stone mining including diamond wire saw, blind cut technique etc.
4. Also get the benefit of processing techniques such as gang saws, automatic tiling plant, multiwire machine for slab making etc.
5. Environmental impact due to mining and processing activities.

UNIT - I

Resources of Marble, Granite, Slate, as Dimensional stones in India and world, uses, marketing, export. Geological, mineralogical and physico-mechanical properties of dimensional stones, Criteria for selection of dimensional stone deposit, Procedure for obtaining mining lease and preparation of project proposal.

UNIT - II

Mining: Conventional mining of Sandstone, Limestone, Marble and Granite; Recent developments-wire saw including blind cut technique, chainsaw, belt saw, hydraulic splitting, flame jet cutting, water channeling etc; Blasting techniques in dimensional stone mines: various types of explosives used, controlled blasting for providing horizontal & vertical cut; Splitting by swelling material.

UNIT - III

Insitu splitting technique used in compact limestone (Kota stone) for utilization of waste as dimensional stone. Various types of loaders cranes and hydraulic excavator used in dimensional stone mines; Quarry layouts. Hole making technique using hole-finder and laser beam. Application and development of diamond tools, formation of stone block and their handling

UNIT - IV

Processing: Dressing- Mono block dresser; Sawing- gang saws, circular saws; Preparation and mounting of blades/discs and segments; slab repair by resin Polishing - Manual, Mechanical; Various types of polishing machines; Abrasives- type, use and selection, shaping; Tile preparation; Automatic tiling plant, slurry handling and treatment including water supply. Multiwire technology.

UNIT - V

Environmental impacts of mining and processing of dimensional stones; Secondary use of quarried land and waste of the industry; Land reclamation, Environmental management plan, Environment Protection measures.

TEXT BOOKS:

1. Dimensional Stone Technology, S. S Rathore., G. S. Bhardwaj and S. C Jain.

REFERENCE BOOKS:

1. Safety and Technology in Marble Mining and Processing in New Millennium, S. S., Rathore and V.; Laxminarayana, Proc. Of National Workshop held March 10-11 200 Udaipur.
2. Recent Development in Machinery and Equipment for Dimensional Stone Mining, S. S. Rathore, Y. C. Gupta and R. L Parmar, held Dec. 13-14, 2003 at Udaipur.

MINING OF DEEP-SEATED DEPOSITS
(Professional Elective – II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To give very highly specialized knowledge to the upcoming mining professionals with future demand of deep seam mining for coal extraction.

Course Outcomes: By end of this course, students will

1. Learn about the classification of complex coal deposits.
2. Identify the challenges, development and design of deep-seated deposits
3. Understand numerical modelling techniques of strata control, monitoring and modern technologies for stability analysis.
4. Learn the usage of modern instruments for strata controlling in deep seated deposits.

UNIT-I

Exploration: Modern Exploration Techniques to Identify the Complex Coal Deposits, Advanced borehole logging techniques.

Classification: Classification of Coal Deposits Lying under Typical Geo-mining conditions.

UNIT-II

Extraction Challenges: Challenges to improve production and productivity from Deep Seated Deposits. Challenges in Liquidation of Locked-up Pillars

Experimental Trials: Innovative Technologies for Stability Analysis.

UNIT-III

Design and Development of Deep Seated Deposits. Long hole open stopping, block caring, back filling

UNIT-IV

Modern Techniques: Application of Numerical Modeling Techniques to Control Ground Problems of Complex Deposits. Ventilation, dewatering, ground support in deep conditions.

UNIT-V

Use of Modern Instruments for Strata Control of deep seated deposits.

In-situ Gasification and Mineral Biotechnology for Complex Coal Deposits.

TEXT BOOKS:

1. Principles & Practices of Modern Coal Mining, R.D. Singh, New age international New Delhi, 1997.
2. Underground winning of Coal, T.N. Singh, Oxford and IBH New Delhi, 1992.

REFERENCE BOOKS:

1. Longwall mining, Peng S S and Chiang H S, Wiley, New York, 708p.
2. Modern Coal Mining Technology, S.K. Das, Lovely prakashan Dhanbad, 1992.

APPLICATIONS OF GEO STATISTICS
(Open Elective – II)

B.Tech. III Year II Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To introduce geostatistics as a spatial data analysis tool applicable across disciplines such as civil, environmental, petroleum, and earth sciences.
2. To develop competency in analyzing, modeling, and predicting spatial phenomena using statistical tools.
3. To provide practical exposure to variography, interpolation methods, and uncertainty quantification in spatial modeling.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand the foundational concepts of geostatistics and its cross-disciplinary relevance.
2. Perform statistical and spatial analysis on data collected from environmental, geotechnical, or agricultural fields.
3. Construct and interpret experimental variograms and model spatial correlation.
4. Apply estimation techniques such as IDW and Kriging for resource distribution, risk assessment, and surface mapping.
5. Use geostatistical software and GIS tools for real-world applications like contamination mapping, rainfall analysis, or soil fertility prediction.

Unit I:

Introduction to Geostatistics: Overview of spatial data and its applications, Distinction between classical statistics and geostatistics, Spatial variability and regionalized variables, Fields of application: environmental monitoring, agriculture, hydrology, petroleum, Geotech, Types of spatial data: point, block, grid, and polygon.

Unit II:

Statistical Fundamentals for Spatial Data: Data exploration and descriptive statistics, Histograms, box plots, QQ plots, Probability distributions relevant to spatial modelling, Sampling strategies for spatial datasets, Data transformation and declustering techniques

Unit III:

Variogram and Spatial Continuity Analysis: Concepts of spatial autocorrelation and stationarity, Experimental variogram: construction and interpretation, Variogram models: spherical, exponential, Gaussian, Fitting models and cross-validation, Directional variograms and anisotropy

Unit IV:

Spatial Estimation and Interpolation Techniques: Classical interpolation: nearest neighbor, IDW, moving average, Introduction to Kriging: simple, ordinary, and block Kriging, Applications of Kriging in environmental and civil domains, Accuracy assessment and error estimation, Case studies: groundwater contamination mapping, rainfall interpolation.

Unit V:

Software Applications and Case Studies: Introduction to geostatistical tools: ArcGIS, QGIS (with SAGA), Surfer, R (geoR, gstat), Workflow for geostatistical modeling and surface generation, Case studies: Agricultural yield prediction, Geotechnical site investigation, Air/water quality mapping, Oil & gas reservoir modeling.

REFERENCE BOOKS:

1. M. David, Geostatistical Ore Reserve Estimation, Elsevier (foundational text for geostatistics).
2. Jean-Paul Chiles & Pierre Delfiner, Geostatistics: Modeling Spatial Uncertainty, Wiley.
3. Isobel Clark & William V. Harper, Practical Geostatistics 2000, Ecosse North America.
4. Burrough, P.A., and McDonnell, R.A., Principles of Geographical Information Systems, Oxford University Press.
5. Bohling, Geoffrey C., Introduction to Geostatistics and Variogram Analysis, University of Kansas (free online source or lecture notes).
6. Hengl, T., A Practical Guide to Geostatistical Mapping of Environmental Variables, EUR Report (Open access).

HEALTH AND SAFETY IN MINES
(Open Elective - II)

B.Tech. III Year II Sem.

L	T	P	C
2	0	0	2

Pre-Requisites: NIL

Course Objectives: To brief mining students in health and safety engineering concepts, causes of accident, training, human behavioural approach in safety etc.

Course Outcomes: Student will able to

1. Gain knowledge and able to understand the importance of health and safety including the role of safety risk assessment in mining industry
2. Acquire knowledge about accidents, classification of accidents, accident analysis and report preparation
3. Learn identification of causes of hazards and able to implement preventive measures
4. Learn about safety analysis and loss control operations such as ZAP, MAP etc.
5. Use risk minimization techniques and risk analysis techniques FTA, HAZOP, ETA etc.

UNIT - I

Introduction to accidents, prevention, health and safety in industry: Terminology, reason for preventing accidents – moral and legal.

Safety scenario in Indian mines, Accidents in Indian mines, Measurement of safety performance. Classification of accidents as per Mining legislation/law and general classification of accidents.

UNIT - II

Causes and preventive measures of accidents in underground and opencast mines i.e., due to fall of roof and sides, transportation of machinery, haulage and winding, drilling and blasting, movement of machinery in opencast mines and electricity etc., ; accident analysis and report, cost of accidents, statistical analysis of accidents and their importance for promotion of safety.

UNIT - III

System engineering approach to safety, techniques used in safety analysis, generic approach to loss control within mining operations. Concept of ZAP and MAP.

UNIT - IV

Risk management, Risk identification, Risk estimation and evaluation, Risk minimization techniques in mines. Risk analysis using FTA, HAZOP, ETA etc; health risk assessment and occupational diseases in mining.

UNIT - V

Development of safety consciousness, publicity and propaganda for safety; training of workmen, Human Behavioral approach in safety, safety polices and audio-visual aids, safety drives campaigns, safety audit. Safety management and organization; Internal safety organization.

TEXT BOOKS:

1. Occupational Safety and Health in Industries and Mines by C.P. Singh
2. Mine Safety and Legislation. S.K. Das, Lovely Prakashan, Dhanbad, 2002

REFERENCE BOOKS:

1. System Safety Engineering and Risk Assessment: A Practical Approach, N.J. Bahr, Taylor and Francis, NY, 1997.
2. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad.

MINERAL PROCESSING LAB

B.Tech. III Year II Sem.

L	T	P	C
0	0	3	1.5

Course Objectives:

To introduce technology involved in crushing /grinding/classification and concentration techniques.

Course Outcomes:

The students will be able to

1. Determine the crushing and grinding characteristics of minerals.
2. Determine the efficiency of magnetic separator and forth flotation cell.
3. Know about different types of separators and sedimentation process.
4. Study the different types of mineral processing machinery components.

LIST OF EXPERIMENTS:

1. Study of grab sampling and different sample division techniques like coning and quartering, riffle sampling 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 using ball mill.
4. Sieve analysis of a given sample and to calculate (a) percentage CMF retained and percentage CMF passed through on screens (b) average size of sample 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 wash-ability characteristic of coal samples using sink-float tests.
9. Study of sedimentation characteristics of a given mineral sample
10. Determination of Hard Grove Grind-ability Index of ore or mineral or coal.
11. Determination of Bonds work index for rock or ore or mineral.

GROUND CONTROL LAB

B.Tech. III Year II Sem.

L	T	P	C
0	0	3	1.5

Course Objective:

1. To provide hands-on experience with instruments, equipment, and techniques used in monitoring and maintaining ground stability in surface and underground mines.
2. To develop analytical and interpretative skills related to strata behavior, rock mass properties, and ground support systems.

Course Outcome:

By the end of the course, students will be able to:

1. Identify and classify different types of strata hazards and geotechnical issues in mining.
2. Apply field and lab methods to measure rock mass properties and evaluate ground conditions.
3. Analyze the design and effectiveness of various ground support systems used in mines.
4. Demonstrate the use of ground control instruments and interpret their readings for strata movement.
5. Evaluate and recommend suitable ground control techniques to mitigate hazards in specific mining conditions.

LIST OF EXPERIMENTS

1. Determination of RQD (Rock Quality Designation) of drill core samples
2. Measurement of Point Load Strength Index of rocks
3. Determination of Uniaxial Compressive Strength (UCS) of rocks
4. Determination of Tensile Strength using Brazilian Test
5. Study and use of Strain Gauge
6. Study of Roof Bolting and installation techniques
7. Determination of Rock Mass Rating (RMR)
8. Determination of Q-system (Tunneling Quality Index)
9. Study and use of convergence monitoring instruments (Tell-tale, convergence meter)
10. Study of ground monitoring instruments (Extensometer, Inclinometer, etc.)
11. Demonstration of shotcrete application and support system
12. Case Study/Field Visit Report on Ground Control Measures in Operating Mines

REFERENCE BOOKS:

1. B.S. Verma, Mine Safety and Ground Control, Khanna Publishers.
2. R. N. Singh, Principles and Practices of Modern Ground Control in Mines, Oxford & IBH Publishing.
3. E. Hoek and J. W. Bray, Rock Slope Engineering, CRC Press.
4. J. A. Hudson & J. P. Harrison, Engineering Rock Mechanics, Pergamon.
5. T. Ramamurthy, Engineering in Rocks for Slopes, Foundations and Tunnels, PHI Learning.

MINE PLANNING & DESIGN LAB

B.Tech. III Year II Sem.

L	T	P	C
0	0	2	1

Course Objective:

1. To develop practical skills in mine planning through manual methods of design, scheduling, and cost estimation.
2. To enable students to calculate key production, equipment, and economic parameters for efficient mine operations.
3. To introduce students to the planning, design, and evaluation processes involved in surface and underground mine projects

Course Outcome:

By the end of the lab, the student will be able to:

1. Calculate ultimate pit limits, stripping ratios, and mine geometries using manual techniques.
2. Design mine access entries and estimate equipment requirements based on production targets and terrain conditions.
3. Compute manpower needs, productivity indices, and fleet size using standard formulas and empirical methods.
4. Perform financial evaluations of mining projects including NPV, IRR, and cost estimations for closure and ESCROW.
5. Prepare a manual production calendar, lead/lift planning, and blast design calculations for operational scheduling.

LIST OF EXPERIMENTS

1. Determination of Ultimate Pit Limits using Hand Calculation Method
2. Stripping Ratio Calculation for Various Pit Depths and Geometries
3. Preparation of Lead, Lift and Production Calendar Plan using Manual Scheduling
4. Design of Mine Entries (Shaft or Incline) Based on Orebody Depth
5. Estimation of Equipment Requirements and Productivity Calculations
6. Blast Design Geometry calculation, explosive requirement, Muckpile characteristics / Face Pull calculation, OMS and Fleet calculation in Mines.
7. Calculation of Shaft Pillar Dimensions using Empirical Formula.
8. Computation of Manpower Requirement and Productivity Indices
9. Estimation of Preliminary Mine Activities and ESCROW Costs.
10. Manual Economic Evaluation of a Mining Project (NPV, IRR, Payback Period)

MINE LEGISLATION AND GENERAL SAFETY

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

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 student's career is mainly dependent on mining industry, exposure to state and central laws related to mining are highly solicited.

1. This course gives an opportunity for the students to understand the statutions requirement for coal/metal mining by opencast/underground methods.
2. Students get idea of how mining laws and legislation evolved in India
3. Students will understand statutory rules, regulations and byelaws etc.
4. Students acquire knowledge of accidents, causes of accidents and report preparation
5. Students will know about safety management, safety audit and their importance.

UNIT - I

Introduction to mining laws and legislation, General principles of mining laws and development of mining legislation in India. The Mines Act, 1952, The Mines Rules, 1955.

UNIT - II

The Mines Vocational Training Rules, 1966; The Mines Rescue Rules, 1985.
The Mines Maternity Benefit Act, 1961 in brief; Payment of Wages Act, 2005; NCWB agreement (in brief).

UNIT - III

Coal Mines Regulations, 2017; Metalliferous Mines Regulations, 1961.

UNIT - IV

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

UNIT - V

General causes of accidents in mines and their prevention. Accident enquiry reports, cost of accidents, occupational diseases.
Safety management plan. Safety audit, risk management.

TEXT BOOKS:

1. The Mines Act, 1952.
2. The Mines Rules, 1955.
3. The Mines Vocational Training Rules, 1966.
4. The Mines Rescue Rules, 1985.
5. The Mines Crèche rules, 1996
6. The Employee's (Workmen's) Compensation Act, 2010.
7. Indian Electricity Rules, 1956.
8. Coal Mines Regulations, 1957.
9. Metalliferous Mines Regulations, 1961.
10. Mines and Minerals (Regulation and Development) Act 1957.
11. The Mineral Concession Rules, 1960.
12. The Mineral Conservation and Development Rules, 1988.

REFERENCE BOOKS:

Legislation in Indian Mines: A Critical Appraisal vol.1&2 – Rakesh and Prasad.

UNDERGROUND METAL MINING TECHNOLOGY

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

1. To introduce concepts of metal mining and metal mining terminology.
2. To study development and operations of metal mines.
3. To study about special methods of metal mining methods.
4. To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

Course Outcomes:

1. The students will have basic concept on metal mining methods, classification of mining methods and selection of appropriate method
2. Learn about mine design, development and operations of metal mines and production scheduling.
3. They will also know about techno-economical parameters effecting stopes and design of stopes for optimum production
4. Understand about parameters effecting selection of equipment and learns about organisation of metal mines
5. They will also know about novel methods of metal mining and its applications.

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

REFERENCE BOOKS:

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

GEO-STATISTICS
(Professional Elective – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the fundamental concepts and statistical tools required to analyze spatial and geological variability in mining.
2. To equip students with skills to apply classical and geostatistical methods for resource estimation and grade control.
3. To develop the ability to use software and statistical models for interpreting mining and exploration data with uncertainty quantification.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand the principles of probability, univariate and multivariate statistics in the context of mining data.
2. Apply spatial statistics to model variability of ore grades and geological attributes. Perform variogram analysis and interpret spatial correlation structures in mineral deposits.
3. Estimate ore reserves using interpolation techniques such as Kriging and Inverse Distance Weighting (IDW).
4. Utilize geostatistical software/tools for data analysis and decision-making in exploration and mine planning.

Unit I:

Introduction to Geo-statistics and Basic Concepts: Definition and scope of geo-statistics in mining, Random variables, probability distributions, and frequency analysis, Descriptive statistics: mean, variance, skewness, kurtosis, Data quality, declustering, and data transformation, Geological continuity and spatial variability

Unit II:

Spatial Data and Sampling Techniques: Sampling methods in mining and exploration (random, systematic, stratified), Spatial data types: point, block, regionalized variables, Data validation, compositing, and outlier detection, Histograms, probability plots, QQ plots, Grade-tonnage curve and cut-off grade estimation

Unit III:

Variography and Spatial Correlation: Spatial autocorrelation and stationarity, Experimental variogram: types, construction, and interpretation, Variogram models: spherical, exponential, Gaussian, Nugget, sill, range concepts, Cross-variograms and anisotropy analysis.

Unit IV:

Estimation Techniques: Classical estimation: moving average, inverse distance weighting (IDW), Kriging: simple, ordinary, and universal, Block kriging and estimation variance, Cross-validation and model accuracy assessment, Application of kriging in ore reserve estimation and mine planning.

Unit V:

Software Applications and Case Studies: Overview of geostatistical software (e.g., Surfer, Datamine, Geovia, R/GeoR), Geostatistical workflows in resource modelling, Case studies: mineral resource estimation, grade modeling, geometallurgy, Uncertainty modeling and risk analysis in reserve estimation, Integration with GIS and remote sensing datasets

REFERENCE BOOKS:

1. M. David, Geostatistical Ore Reserve Estimation, Elsevier.
2. G. Matheron, Principles of Geostatistics, Economic Geology Publishing.
3. J.-P. Chiles & P. Delfiner, Geostatistics: Modeling Spatial Uncertainty, Wiley.
4. R. Dimitrakopoulos, Advances in Orebody Modelling and Strategic Mine Planning, The Australasian Institute of Mining and Metallurgy (AusIMM).
5. Isobel Clark & William V. Harper, Practical Geostatistics 2000, Ecosse North America.
6. Leuangthong, Cox & Deutsch, Geostatistics for Environmental and Geotechnical Applications, ASCE Press.

MINE SYSTEMS ENGINEERING
(Professional Elective – III)

B.Tech. IV Year I Sem. **L T P C**
3 0 0 3

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

Course Outcomes:
On completion of the course the students will be able to:
1. Apply LPP for optimizing complex problems.
2. Solve transportation and assignment problems.
3. Optimize sequencing problems.
4. Optimize using gaming theory.
5. Demonstrate the concepts of CPM and PERT.

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.

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/

ROCK EXCAVATION ENGINEERING
(Professional Elective - III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: To understand the rock mechanics, rock cutting technology, rock cutting tools and rock excavating machine

Course Outcomes: The students will

1. Have knowledge about mechanism of rock excavation process and different rock fragmentation methods.
2. Know about the influence of different rock properties in rock excavation such as abrasivity, lamination and joints etc.
3. Acquire knowledge on rock cutting technology
4. Understand about different types of cutting tools, their mechanism and application
5. Have insight in to rock excavating machines, their application and technical indices of machines.

UNIT - I

Introduction: Concepts, historical developments in rock excavation systems, factors affecting the rock fragmentation, mechanism of rock breakage and fracture; their application to rock fragmentation methods– explosive action, cutting, ripping and impacts.

UNIT - II

Rock Properties: Rock properties related to excavation process; application of compressive, tensile and tri- axial strengths, index tests and abrasivity, anisotropy, elasticity, porosity, laminations, bedding and jointing in rock fragmentation process.

UNIT - III

Rock Cutting Technology: Mechanism of drilling – rotary, percussive, rotary percussive, mechanics of rock cutting, theory of single tool rock cutting, crack initiation and propagation, breakage pattern, rock excavation by cutting action – picks, discs, roller cutters, water jet cutting, methods of evaluation of drill ability and cut ability index of rocks.

UNIT - IV

Rock Cutting Tools: Rock cutting tool materials, different types, relative applications and their choice, tool shape and size, specific energy consumption, tool wear, effect of operational parameters on tool performance, maintenance and replacement of cutting tools of excavating machines.

UNIT- V

Rock Excavating Machines: Excavating machines, principles, operation, applicability and technical indices of road headers, TBM'S coalface machines and bucket wheel excavators.

TEXT BOOKS:

1. Introductory Mining Engineering, Hartman, H.L., John Wiley and Sons, New York, 1987.
2. Principles of Rock Fragmentation, Clark, G.B., John Wiley and Sons, New York, 1987.

REFERENCE BOOKS:

1. Mining Engineering Handbook, 3rd edition, Vol I & II, Hartman, H. L. (Editor), SME Society of Mining Engineers, New York, 2011.
2. Diamond Drilling, Chugh, C.P., Oxford-IBH, 1984.

ROCK SLOPE ENGINEERING
(Professional Elective – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the basic mechanics of rock slope failures.
2. To learn the types of rock failure and its influencing parameters.

Course Outcomes: The students will able to

1. Know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters.
2. Understand about geological parameters affecting slope stability, different properties of rocks, determination of shear strength and field measurements of rocks
3. Know details of plane and wedge failures
4. Know details of circular and toppling failure
5. Gain knowledge about slope failure monitoring and stabilization techniques.

UNIT - I

Basic Mechanics of Rock Slope Failure: Rock slope economics; continuum mechanics approach to slope stability; slope parameters; effect of water pressure; factor of safety of slopes; slope height vs slope angle; design of slopes.

UNIT - II

Geological and Rock Strength Properties: Geological parameters affecting slope stability; graphical representation of geological data; plotting and analysis of field measurements; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.

UNIT - III

Plane Failure and Wedge Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability; influence of tension crack; analysis of failure on a rough plane; rock reinforcement of slopes; Analysis of wedge failure; wedge analysis including cohesion and water pressure; Wedge stability charts for friction only; case studies. Numerical problems.

UNIT - IV

Circular and Toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; circular failure charts; Bishop's and Janbu's methods of failure analysis; case studies. Types of toppling failure; secondary toppling modes; analysis of toppling failure; limit equilibrium analysis of toppling failures; Influence of slope curvature on stability; slope depressurisation; protection of slopes; control of rock falls; measurement and monitoring and interpretation of slope displacements. Numerical problems.

UNIT - V

Rock Slope Failure Monitoring and Slope Stabilization: Types of slope movement, Surface and Sub-surface monitoring methods inclusing instrumentation and techniques & Guidelines for monitoring programs. Causes of rock falls; Rock slope stabilization programs – stabilization by rock reinforcement & rock removal; protection measures against rock falls.

TEXT BOOKS:

1. Rock Slope Engineering, Hoek, E and Bray, J.W. Institution of Mining and Metallurgy, 1991.
2. Rock Mechanics, Goodman, R.E., John Wiley and Sons, 1989.
3. Engineered Rock Structures in Mining and Civil Construction, Singh, R.N. and Ghose, A.K., A.A. Balkema, Netherlands, 2006.

REFERENCE BOOKS:

1. Rock Slope Engineering, 4th Edition, Duncan C.Wylie and Chris Mah, CRC Press, 456p, 2004.
2. Guidelines for Open Pit Slope Design, 1st Edition, John Read and Peter Stacey, CRC Press, 510p, 2009.
3. Slope stability in Surface Mining, William A. Hustrulid (Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Society for Mining, Metallurgy, and Exploration, 442p, 2001.
4. Fundamentals of Rock Mechanics, 4th Edition, John Jaeger, N. G. Cook and Robert Zimmerman, Wiley-Blackwell; 4 edition, 488p, 2007.

ENVIRONMENTAL MANAGEMENT IN MINES
(Professional Elective – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

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

Course Outcomes:

After going through this course, students

1. Understand about importance of ecosystem and global environment
2. Know about the environmental impacts due to mining industry.
3. Gain knowledge on legislation and Environmental Impact Assessment (EIA).
4. Get to know about preventive measures on various Environmental Pollution and health hazards.
5. Understand the concept of Sustainable Development and Environmental Management Plan (EMP).

UNIT - I

Ecosystems: Basic concepts, scope and importance of ecosystem. classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids, flow of energy. Factors influencing environmental impacts due to mining.

UNIT - II

Global environment. ozone depletion and Ozone Depleting Substances (ODS), deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal protocol.

UNIT - III

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution- Air Pollution: Primary and secondary pollutants, Ambient air quality standards and control measures. Water pollution: Sources and types of pollution, drinking water quality standards, control measures. Soil Pollution: Sources and types, Impacts of mining on soil. Noise Pollution: sources and health hazards, standards, pollution control technologies: waste water treatment methods: primary, secondary and tertiary.

UNIT - IV

Environmental Policy, Legislation & EIA: Environmental Protection Act 1986, Air Act- 1981, Water Act, Forest Act, Wild life Act

UNIT - V

EIA: structure, methods of baseline data acquisition. Environmental Management Plan (EMP), concepts, structure. Sustainable development of Projects, concepts, structure.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University 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 Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela .2008 PHI Learning 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.

ROCK FRAGMENTATION ENGINEERING
(Professional Elective – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To familiarize the students

1. With highly specialized subject of design of rock breaking techniques
2. With more emphasis on computational models,
3. Different controlled blasting techniques.
4. Required instrumentation for monitoring blasting operations in mines.

Course Outcomes:

This course enables the student

1. To have clear perception of rock fragmentation techniques and its field applications.
2. To understand the general theories of rock cutting and to select appropriate cutting tools.
3. To acquire knowledge of mechanism involved in rock fragmentation and explosive action.
4. To use different types of computational models to design blast patterns and control blasting techniques to prevent adverse effects of blasting
5. To use modern tools and instruments in rock fragmentation.

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, drill ability of rocks, drilling performance and cost of drilling; specific energy in drilling, Pneumatic and Hydraulic rock hammers.

UNIT - II

Mechanics of rock fragmentation and fracture by explosive action, Types of explosives and characteristics blasting accessories, blasting parameters, design of blasting rounds for opencast and underground mines, Blast ability of rocks, blasting efficiency, importance of fragmentation.

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

SLOPE STABILITY TECHNOLOGY
(Open Elective - III)

B.Tech. IV Year I Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To introduce the fundamental principles and failure mechanisms of natural and engineered slopes.
2. To provide students with tools and techniques to assess, analyze, and improve slope stability in civil, mining, and geotechnical projects.
3. To develop the ability to select appropriate stabilization measures and slope monitoring technologies.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand the types of slope failures and key factors affecting slope stability.
2. Analyze slope geometry, soil/rock strength, groundwater, and external loads for slope failure risk.
3. Apply limit equilibrium and numerical methods for slope stability analysis.
4. Evaluate slope reinforcement and stabilization techniques such as retaining structures, drainage, and geosynthetics.
5. Use slope monitoring tools and interpret real-time data for early warning and disaster mitigation.

Unit I:

Introduction to Slope Stability: Definition and significance in civil, mining, and geotechnical engineering, Natural vs. man-made slopes, Types of slope failures: translational, rotational, wedge, compound, toppling, and rock falls, Factors influencing slope stability: geological, hydrological, and human-induced.

Unit II:

Shear Strength and Slope Analysis Fundamentals: Concepts of shear strength in soils and rocks, Mohr-Coulomb failure criterion, Site investigation and sampling techniques, Factor of safety: definition and importance, Introduction to slope classification systems (e.g., SMR, RMR)

Unit III:

Methods of Slope Stability Analysis: Limit equilibrium methods: Swedish (Fellenius), Bishop, Janbu, Spencer, Infinite slope model for shallow failures, Use of charts and software tools (e.g., SLIDE, SLOPE/W), Introduction to finite element and numerical modeling approaches, Case examples in civil and mining projects.

Unit IV:

Slope Stabilization and Reinforcement Techniques: Drainage control and surface water diversion, Retaining walls, rock bolts, soil nails, shotcrete, gabions, Geosynthetics and reinforced soil slopes, Terracing, benching, vegetation, and bioengineering, Cost and feasibility considerations

Unit V:

Slope Monitoring and Risk Management: Slope instrumentation: inclinometers, extensometers, piezometers, total stations, Remote sensing and LiDAR for slope monitoring, Early warning systems and risk zoning, Guidelines for slope failure mitigation and emergency response, National and international standards for slope management

REFERENCE BOOKS:

1. Abramson, L. W., Lee, T. S., Sharma, S., & Boyce, G. M., Slope Stability and Stabilization Methods, Wiley.
2. Duncan, J. M., and Wright, S. G., Soil Strength and Slope Stability, Wiley.
3. Hoek, E., and Bray, J. W., Rock Slope Engineering, CRC Press.

4. Wyllie, D. C., and Mah, C. W., Rock Slope Engineering: Civil and Mining, CRC Press.
5. Bromhead, E. N., The Stability of Slopes, Thomas Telford.
6. IS Code 14496 (Part 2) – Guidelines for Preparation of Landslide Hazard Zonation Maps in Mountainous Terrain

TUNNELLING AND UNDERGROUND SPACE TECHNOLOGY
(Open Elective – III)

B.Tech. IV Year I Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To introduce the significance of tunnels and underground structures in modern infrastructure.
2. To provide knowledge on tunnel planning, alignment, and urban integration.
3. To familiarize students with construction methods suitable for civil and transportation tunnels.
4. To understand support systems, waterproofing, and sustainability in underground space usage.
5. To highlight safety, environmental considerations, and project management in tunnelling works.

Course Outcomes:

After completing the course, students will be able to:

1. Explain the types, functions, and planning principles of tunnels and underground spaces.
2. Select appropriate excavation and construction techniques for civil and urban environments.
3. Understand and design basic tunnel support and waterproofing systems.
4. Evaluate the use of underground space for metros, utilities, and commercial development.
5. Apply safety, environmental, and project management practices in tunnel construction.

UNIT I:

Introduction to Tunnelling and Underground Space: Importance and scope of tunnels in civil infrastructure, transport, and utilities; Classification of tunnels: based on use (transport, utility, pedestrian, commercial), shape, and alignment; Planning of tunnel projects: alignment selection, feasibility study, cost–benefit analysis; Site selection: portals, shafts, and surface constraints in urban settings; Introduction to underground space planning in smart cities.

UNIT II:

Tunnel Construction Methods: Overview of tunnel construction methods: Cut-and-cover method: steps, applications, and limitations; Bored tunnelling using Tunnel Boring Machines (TBMs): types, working, urban applications; Sequential Excavation Method (SEM) and New Austrian Tunnelling Method (NATM); Shield tunnelling and pipe jacking in urban utility projects; Excavation methods for soft soil and mixed ground conditions

UNIT III:

Tunnel Support, Waterproofing, and Lining: Need for support systems during and after excavation; Types of supports: temporary vs permanent; Use of shotcrete, rock bolts, steel ribs, and precast concrete segments; Waterproofing techniques: membranes, drainage layers, joint sealing; Tunnel lining: functions, design principles, and material selection; Settlement control and ground improvement techniques in soft soils

UNIT IV:

Underground Space Utilization and Urban Integration: Concept and benefits of underground space in urban infrastructure; Types of underground structures: metros, parking, retail, pedestrian walkways, utility corridors; Space optimization, architectural and structural design considerations; Case studies: Delhi Metro, Bangalore Metro; Environmental sustainability: reduced land use, heat island mitigation, energy efficiency; Urban planning and policy frameworks for underground development

UNIT V:

Safety, Environmental Impact, and Project Management: Tunnel safety: ventilation, fire protection, gas and water hazards; Environmental impact: noise, vibration, settlement, traffic disruption, mitigation strategies; Tunnel ventilation systems and emergency egress; Risk management in tunnelling projects: identification, assessment, mitigation; Project planning and scheduling: CPM, PERT, logistics; Tunnel inspection, rehabilitation, and lifecycle maintenance

TEXTBOOKS

1. P.W. Baghli – Tunnelling and Tunnel Construction, Oxford & IBH Publishing
2. S.K. Saxena – Tunnelling: Design, Stability, and Construction, CBS Publishers
3. Thomas R. Kuesel & Elwyn H. King – Tunnel Engineering Handbook, John Wiley & Sons
4. Alun Thomas – Sprayed Concrete Lined Tunnels, CRC Press

REFERENCE BOOKS:

1. Bickel & Kuesel – Modern Tunnelling Techniques, Chapman and Hall
2. Z. T. Bieniawski – Tunnels: Planning, Design, Construction, Balkema Publishers
3. David Chapman, Nicole Metje, Alfred Stärk – Introduction to Tunnel Construction, CRC Press
4. S.K. Ghosh – Tunnelling and Underground Structures, Katson Publishing

COMPUTER APPLICATIONS IN MINING LAB

B.Tech. IV Year I Sem.

L	T	P	C
0	0	2	1

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: At the end of this course, the students will able to

1. Use the SURPAC software for surface and underground mining methods.
2. Use the ANSYS software for Design of pillars, barriers and panels.
3. Use the ventilation software for creating ventilation networks and modelling of airflow.
4. Use the blasting software for fragment analysis and optimum blast design.
5. Use the slope stability software for slope stability analysis.

LIST OF EXPERIMENTS

1. Design of pillars, barriers and panels using ANSYS software.
2. Blast design
3. Subsidence prediction using ROCSCIENCE software.
4. Mine ventilation network analysis.
5. Modelling of airflow through underground workings using CFD.
6. Slope stability analysis in pit and dumps.
7. Fragmentation Analysis using FRASLYST software.
8. Surface Mine Design using SURPAC Software
9. Pit optimization using SURPAC Software

REFERENCE BOOKS:

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

MINE SAFETY LAB

B.Tech. IV Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To impart practical knowledge and hands-on skills in identifying, evaluating, and mitigating hazards associated with mining operations.
2. To train students in the use of mine safety equipment and instruments as per statutory standards to ensure occupational health and safe working conditions.

Course Outcomes:

Upon successful completion of the lab, students will be able to:

1. Identify common hazards in underground and surface mines and suggest appropriate control measures.
2. Demonstrate the use of safety equipment and personal protective gear effectively.
3. Monitor environmental parameters (like gas concentration, temperature, humidity) critical to miner health.
4. Operate mine rescue and fire-fighting equipment and understand protocols during emergencies.
5. Evaluate safety practices and procedures in line with DGMS regulations and suggest improvements.

LIST OF EXPERIMENTS

1. Study and demonstration of various types of Personal Protective Equipment (PPE)
2. Calibration and use of Multi-Gas Detector
3. Use of Methanometer and Flame Safety Lamp
4. Demonstration of Self-Contained Breathing Apparatus (SCBA)
5. Study of Fire Extinguishers – types, uses, and live demonstration
6. Determination of Noise Levels using Sound Level Meter
7. Measurement of Illumination Levels in mines using Lux Meter
8. Study and demonstration of Rescue Station Equipment
9. Preparation and execution of Emergency Response Plan (ERP)
10. Monitoring of Temperature and Humidity using Hygrothermograph
11. Demonstration of First Aid Techniques for mining accidents
12. Case Study / Safety Audit / Accident Analysis Report

REFERENCE BOOKS:

1. S. Ghatak, Mine Accidents and Safety, The Mining Publishers.
2. Dr. R.T. Deshmukh & D.J. Deshmukh, Elements of Mining Technology, Vol. 1–3, Denett Publications.
3. Mines Rescue Rules, Directorate General of Mines Safety (DGMS), Government of India.
4. ILO & DGMS Guidelines on Safety and Health in Underground Coal Mines
5. S.K. Das, Mine Safety and Legislation, Lovely Prakashan.

RISK ASSESSMENT AND MANAGEMENT IN MINES
(Professional Elective – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: NIL
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:
1. To understand the terminology and reason for preventing accidents, components of Risk Assessment.
2. To learn about concepts of risk assessment and understand qualitative and quantitative approaches based on accident trends in mining industry
3. To have insight in to components of risk assessment such as risk identification, estimation and evaluation etc.
4. To perform epidemiological studies.
5. Apply the Safety Policies, Safety Audit and Safety Management in Mines.

UNIT - I
Introduction to Accident Prevention and Health & Safety in Industry: Basic concepts, Reason for preventing accidents – moral, cost, legal.

UNIT - II
Accident statistics and trends in mining industry; Risk Assessment techniques: Concepts, Qualitative and Quantitative Approaches;

UNIT - III
Components of Risk Assessment: Risk Identification, Risk Estimation and Evaluation; Risk Analysis using WRAC (Workplace Risk Assessment and Control) FTA, HAZOP, ETA, Risk Analysis Softwares; logun for ETA &FTA available for fire. Risk Minimization Techniques in Mines;

UNIT - IV
Epidemiological Studies; Statistical and Economic Analysis of Accident Data; Behavior based safety approaches.

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

REFERENCE BOOKS:
1. Accident Prevention and Safety Management in Mines, A. Bhattacharya, Short Term Course, Nov. 30-3rd Dec., 2004, IIT, Kharagpur, 2004.
2. Hazard Analysis Techniques for System Safety, A. Clifton, Ericson II, John Wiley & sons, New Jersey, Canada, 2005.

IoT APPLICATIONS IN MINING
(Professional Elective – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the fundamental concepts of IoT and its architecture, with a focus on its applicability in mining operations.
2. To develop an understanding of IoT-based data acquisition, communication protocols, and intelligent decision-making in mining systems.
3. To enable students to design, implement, and analyze IoT-based applications for safety, automation, and environmental monitoring in mining.

Course Outcomes:

By the end of this course, students will be able to:

1. Explain the architecture, components, and protocols of IoT systems and their relevance in the mining industry.
2. Apply suitable IoT devices, sensors, and communication protocols for data acquisition and transmission in mining environments.
3. Analyze real-time IoT applications in predictive maintenance, autonomous operations, and environmental monitoring for smart mining.
4. Evaluate the role of IoT in enhancing miner safety through wearables, emergency systems, and remote risk management.
5. Design and implement basic IoT-based prototypes or applications for mining scenarios using microcontrollers and sensors.

UNIT I

Introduction to Internet of Things (IoT) in mining: Understanding the concept of the Internet of Things (IoT) and its relevance in the mining industry, Overview of IoT architecture and components, IoT protocols, IoT-enabled devices and sensors in the mining environment, Benefits and challenges of implementing IoT in mining operations

UNIT II

IoT Data Collection and Communication in Mining: Data acquisition and collection techniques in mining using IoT sensors, Communication protocols and networks for IoT in mining, Edge computing and fog computing in mining IoT systems, Security and privacy considerations in IoT data transmission in mining.

UNIT III

Smart Mining Operations with IoT: Real-time monitoring and control of mining equipment through IoT, Predictive maintenance and condition monitoring using IoT data, Autonomous mining vehicles and robotics in IoT-driven mining operations, Environmental monitoring and sustainability through IoT in mining.

UNIT IV

IoT and Safety in Mining: IoT applications for enhancing safety and reducing accidents in mining, Wearable devices and smart personal protective equipment (PPE) for miners, Emergency response systems and remote monitoring in hazardous areas, Risk assessment and management with IoT data analytics in mining.

UNIT V

IoT Applications in Mining: Mictrocontroller and their capabilities for IoT applications, Selection and integration of sensors relevant to mining scenarios (e.g., temperature, humidity, gas), Design and implementation of a mining- specific IoT application, IoT in Strata Control, IoT in Environment monitoring etc. IoT in slope montoring case studies.

REFERENCE BOOKS

1. Internet of Things for Architects" by Perry Lea
2. IoT Solutions in Microsoft's Azure IoT Suite" by Scott Klein and Paolo Patierno
3. Smart Mining: Resources for a Connected World" by William M. Bajjali
4. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro
5. IoT for Intelligent Mining and Agriculture" edited by Saraju P. Mohanty, Elias Kougianos, and Sudip Misra
6. Industrial Internet of Things: Cyber-Manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat
7. Mining Equipment Reliability, Maintainability, and Safety" by Balbir S. Dhillon
8. IoT Projects with Arduino" by Marco Schwartz and Olivier Engler
9. Real-Time Environmental Parameters Monitoring System using IoT-based LoRa 868-MHz Wireless Communication Technology in underground mines. IEEE Access, Vol:2 : 7430 – 7455.
10. Development of reliable wireless communication system to monitor environmental parameters from various positions of underground mines to the surface using Zig Bee modules, Journal of the Institutions of Engineers (India), Series D; Vol- 105, Pages 359-383.

GIS AND REMOTE SENSING
(Professional Elective – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: To familiarize students with the resources of dimensional stone in India & abroad and basic concept of mining techniques for all types of dimensional stones, processing techniques, multiwire technology and study about environmental impact in surrounding.

Course Outcomes: Dimensional Stone Technology is important to get idea to excavate blocks of marble, granite, sandstone etc.

1. Students will get an idea of resources for dimension stones and Indian dimension stone mining trend.
2. Understand the criteria for selection of dimension stone deposit and procedure of obtaining statutory permissions
3. Students get a benefit of detailed understanding of various techniques of dimensional stone mining including diamond wire saw, blind cut technique etc.
4. Also get the benefit of processing techniques such as gang saws, automatic tiling plant, multiwire machine for slab making etc.
5. Environmental impact due to mining and processing activities.

UNIT – I
Introduction to Remote Sensing: Terminology and Basic principles of Remote Sensing. Electromagnetic radiation and spectrum. Types of platforms: Air borne and Satellite. Sensors: Optical, Thermal, Microwave. Indian and International Satellites: Introduction to RS, LANDSAT, SPOT, IKONOS. Image acquisition and characteristics.

UNIT – II
Image interpretation and digital Image processing: Image Interpretation Techniques: Visual and Digital. Elements of Image Interpretation. Digital image processing: Pre-Processing, enhancement, classification.
Image classification: Image classification: Supervised and supervised, Image rectification and mosaicking.

UNIT – III:
Introduction to GIS: Definition, components and functioning of GIS. Data types: Spatial and spatial. Spatial data models: Raster and vector. Map Projection and coordinate system. Data input, editing and attribute management.

UNIT – IV:
Spatial Analysis and GIS operations: Spatial data querying, overlay, buffering: Raster and Vector - based analysis. DEM and terrain modelling. GIS database managerial and topology. Integration of GIS and Remote sensing.

UNIT – V:
Application in mining and environmental studies: Mineral potential mapping, Lineament and lithological mapping, Mine hazard mapping and Subsidence monitoring land reclamation and EIA using Remote Sensing and GIS. Case studies in Indian mining sector.

TEXT BOOKS:

1. Remote sensing and GIS, B.C. panda (viva Books).
2. Introduction to Geographic information system, Kang-Tsung chang (Mc Graw Hill)
3. Principles of R.S., G.S. Srivastara (Manek Publication)
4. Ralph W. Kiefer and Thomas Lillesand :Remote sensing and Image Interpretation.
5. Rao; Global navigation satellite systems.

MINE ECONOMICS
(Professional Elective - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: NIL

Course Objectives:

1. Study of estimation and valuation of mineral deposits
2. Study of project appraisal
3. Study of finance and accounting

Course Outcome: The students will have knowledge on

1. Role of mining industry in national economy and risk factors in mine investment
2. Different sampling methods and estimation of reserves.
3. Different mine economic valuation methods like profitability index and hoskold's two rate method.
4. Evaluation of exploratory mining areas and various project appraisal methods.
5. Finance, accounting and cost estimation of various mining operations.

UNIT - I

Introduction: Mineral industry and its role in national economy; world and national mineral resources; special risk factors in mine investment and evaluation; national mineral policy-2009.

UNIT - II

Sampling and Ore Reserve Estimation: Methods of sampling, sampling frequency; analysis of sampling data, introduction estimation of reserves, introduction to geo-statistical 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; 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, 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. Mineral and Mine Economics, Deshmukh, R.T., Mira Publications, Nagpur, 1986.
2. Courses in Mining Geology, Arogyaswamy, R.N.P. Oxford and IBH Publishing Co., 1994.

REFERENCE BOOKS:

1. Mine Management, Sloan, D.A., Chapman and Hall, London, 1983.
2. Mineral economics, Chatterjee, K.K., Wiley Eastern, 1992.
3. Examination and Valuation of mineral property, Park, R.J.
4. How to read a balance sheet ILO 1992.
5. Indian Mining Year Book 1994 – MMRD Act and Mineral Concession Rules.

MINE WASTE MANAGEMENT
(Professional Elective - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To familiarize students with the types, characteristics, and environmental impacts of various mine wastes including overburden, tailings, and slag.
2. To develop competency in designing and implementing waste management practices in accordance with regulatory standards.
3. To equip students with sustainable strategies for reclamation, rehabilitation, and reuse of mine waste.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Identify and classify different types of waste generated during mining and mineral processing operations.
2. Analyze the environmental and health impacts of improper mine waste disposal.
3. Design and evaluate systems for tailings disposal, waste rock dumps, and mine water treatment.
4. Apply regulatory frameworks and environmental guidelines in the management of mine waste.
5. Propose sustainable mine closure, land reclamation, and waste reuse solutions for different mining conditions.

Unit I

Introduction to Mine Waste: Basic concepts and types of mine waste: overburden, tailings, slag, waste rock, Sources and generation of waste in surface and underground mining, Physical and chemical characteristics of mine wastes, Volume estimation and classification of solid and liquid waste, Case examples from coal, metal, and non-metal mines

Unit II

Environmental Impacts of Mine Waste: Acid mine drainage (AMD): formation, chemistry, and control, Heavy metal leaching and groundwater contamination, Dust and particulate emissions from dumps, Impact on surface water, biodiversity, and human health, Risk assessment and monitoring programs

Unit III

Tailings and Waste Rock Management: Tailings disposal methods: wet, dry, paste, backfilling, Design of tailings storage facilities (TSFs) and stability considerations, Waste rock dump design: slope, drainage, erosion control, Geotechnical and hydrological aspects of dump management, Use of geomembranes and liners for seepage control

Unit IV

Mine Water Management and Regulations: Sources and types of mine water: pit water, process water, seepage,Mine water treatment: physical, chemical, and biological methods, Legislative framework: Indian Environmental Laws, MoEF, CPCB, and DGMS guidelines, Environmental Impact Assessment (EIA) and Environmental Management Plans (EMP), Reporting and compliance under national/international regulations

Unit V

Sustainable Practices and Reclamation: Mine closure planning and post-closure monitoring, Progressive and final mine reclamation techniques, Reuse of mine waste: construction materials, backfilling, landscaping, Case studies: successful mine waste management in India and abroad, Circular economy in mining and best management practices (BMPs)

REFERENCE BOOKS:

1. Blowes, D. W., & Logsdon, M. J., Environmental Geochemistry of Minesite Drainage, Society for Mining, Metallurgy and Exploration (SME).
2. Ghosh, T. N., Environment and Ecology in the Mining Industry, Scientific Publishers.
3. Lottermoser, B. G., Mine Wastes: Characterization, Treatment and Environmental Impacts, Springer.
4. Lunarzewski, L. W., Mine Drainage and Water Management, Balkema Publishers.
5. Sengupta, M., Environmental Impacts of Mining: Monitoring, Restoration, and Control, CRC Press.
6. (Optional) Indian Bureau of Mines (IBM) – Manual on Mine Waste Management and Reclamation

SUSTAINABLE MINING PRACTICES
(Professional Elective - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the principles of sustainability and their application in mining operations, resource management, and environmental protection.
2. To develop understanding of best practices and frameworks for minimizing ecological and social impacts of mining.
3. To provide knowledge of policies, technologies, and reporting mechanisms used for achieving sustainable mining.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand the fundamental principles of sustainability in the context of mining engineering.
2. Analyze the environmental, social, and economic impacts of mining activities.
3. Apply best practices in mine planning, operation, and closure to enhance sustainability.
4. Evaluate the effectiveness of sustainable technologies and environmental management systems in mining.
5. Interpret sustainability reporting standards, legal frameworks, and stakeholder engagement practices in mining.

Unit I

Introduction to Sustainability in Mining: Basic Concepts of sustainable development, Principles and importance of sustainable mining, Sustainable Development Goals (SDGs), Triple Bottom Line approach (People, Planet, Profit), Role of mining in circular economy

Unit II

Environmental Management in Mining: Environmental impacts of mining (air, water, land, biodiversity), Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), Waste and tailings management, mine water management, Air and noise pollution control techniques, Best Available Technologies (BAT) for environmental protection

Unit III

Social and Economic Sustainability in Mining: Stakeholder engagement and corporate social responsibility (CSR), Community development and benefit-sharing models, Resettlement and rehabilitation policies, Occupational health and safety in sustainable mining, Ethics and transparency in mining operations

Unit IV

Sustainable Mine Planning and Closure: Life cycle approach in mine planning, Sustainable extraction and resource efficiency, Energy efficiency and carbon footprint reduction in mining, Mine closure planning and post-closure land use, Mine reclamation and ecosystem restoration practices

Unit V

Frameworks, Standards, and Case Studies: Government regulations and policies on sustainable mining (MoEFCC, DGMS, IBM), Sustainable mining practices in India and abroad: Case studies, Digital tools and innovation for sustainable mining (IoT, AI Blockchain)

REFERENCE BOOKS:

1. B. A. Kennedy, Surface Mining, SME – Chapters on reclamation and sustainability.
2. Sinha, R. K. & Ghosh, R., Environmental Issues and Sustainable Development in Mining, Scientific Publishers.
3. A. K. Ghose, Sustainable Development and Mining, Allied Publishers.

4. Laurence, D., Social License to Operate: Sustainable Mining, CRC Press.
5. N. L. Pande, Mine Environment and Ventilation, Chapter on environmental controls and sustainability.
6. Reports from Indian Bureau of Mines (IBM), Ministry of Environment, Forest and Climate Change (MoEFCC).