

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in MINING ENGINEERING
COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	PH102BS	Engineering Physics	3	1	0	4
3	CS103ES	Programming for Problem Solving	3	1	0	4
4	ME104ES	Engineering Graphics	1	0	4	3
5	PH105BS	Engineering Physics Lab	0	0	3	1.5
6	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	13	3	10	18

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	CH202BS	Chemistry	3	1	0	4
3	ME203ES	Engineering Mechanics	3	1	0	4
4	ME205ES	Engineering Workshop	1	0	3	2.5
5	EN205HS	English	2	0	0	2
6	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	12	3	8	19.0

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	MN302ES	Fluid Mechanics and Hydraulic Machines	3	1	0	4
3	ME302ES	Mechanics of solids	3	0	0	3
4	MN304PC	Mine Surveying	3	1	0	4
5	MN305PC	Development of Mineral Deposits	3	0	0	3
6	MN306PC	Mine Surveying – I Lab	0	0	2	1
7	AE306ES	Mechanics of Solids Lab	0	0	2	1
8	MN307ES	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	18	3	6	21

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MN401ES	Mining Geology	3	0	0	3
2	EE401ES	Basic Electrical and Electronics Engineering	3	0	0	3

3	MN403PC	Mine Mechanization - I	3	1	0	4
4	MN404PC	Drilling and Blasting	3	1	0	4
5	MN405PC	Mine Environmental Engineering - I	3	0	0	3
6	EE409ES	Basic Electrical and Electronics Engineering Lab	0	0	2	1
7	MN407ES	Mining Geology lab	0	0	3	1.5
8	MN408PC	Mine Surveying – II Lab	0	0	3	1.5
9	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	15	2	10	21

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MN501PC	Introduction to Industrial Engineering	3	0	0	3
2		Professional Elective - I	3	0	0	3
3	MN502PC	Mine Environmental Engineering -II	3	1	0	4
4	MN503PC	Mine Mechanization-II	3	1	0	4
5	MN504PC	Surface Mining Technology	3	1	0	4
6	MN505PC	Mineral Processing Engineering Lab	0	0	3	1.5
7	MN506PC	Mine Environmental Engineering Lab	0	0	3	1.5
8	MN507PC	Mine Mechanization Lab	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	18	3	8	22

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective – I	3	0	0	3
2		Professional Elective – II	3	0	0	3
3	MN601PC	Introduction to Instrumentation	3	1	0	4
4	MN602PC	Underground Coal Mining Technology	3	1	0	4
5	MN603PC	Rock Mechanics Engineering	3	1	0	4
6	MN604PC	Ground Control & Instrumentation Lab and Computer Applications in Mining Lab	0	0	3	1.5
7	MN605PC	Rock Mechanics Engineering Lab	0	0	3	1.5
8	EN608HS	Advanced Communication Skills Lab	0	0	2	1
9	*MC609	Environmental Science	3	0	0	0
		Total Credits	18	3	8	22

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – II	3	0	0	3
2		Professional Elective – III	3	0	0	3
3		Professional Elective - IV	3	0	0	3
4	MN701PC	Underground Metal Mining Technology	3	0	0	3
5	MN702PC	Mine Legislation	3	0	0	3
6	MN703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	MN704PC	Seminar	0	0	2	1
8	MN705PC	Project Stage - I	0	0	6	3
		Total Credits	15	0	8	21

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	MN801PC	Project Stage - II	0	0	14	7
		Total Credits	9	0	14	16

***MC - Environmental Science – Should be Registered by Lateral Entry Students Only.**

***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Professional Elective - I

MN511PE	Environmental Management in Mines
MN512PE	Tunneling Engineering
MN513PE	Mining of Deep-Seated Deposits

Professional Elective - II

MN611PE	Computer Applications in Mining
MN612PE	Mineral Processing
MN613PE	Material Management in Mines

Professional Elective – III

MN711PE	Advanced Surface Mining
MN712PE	Rock Fragmentation Engineering
MN713PE	Risk Assessment and Management

Professional Elective – IV

MN721PE	Rock Slope Technology
MN722PE	Mine Systems Engineering
MN723PE	Dimensional Stone Technology

Professional Elective – V

MN811PE	Mine Planning and Design
MN812PE	Geo-statistics
MN813PE	Rock Excavation Engineering

Professional Elective -VI

MN821PE	Mine Economics
MN822PE	Mineral Exploration
MN823PE	Mine Subsidence Engineering

MA101BS: MATHEMATICS - I**B.Tech. I Year I Sem.**

L	T	P	C
3	1	0	4

Course Objectives: To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form
- Concept of Sequence.
- Concept of nature of the series.
- Geometrical approach to the mean value theorems and their application to the mathematical problems
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative
- Finding maxima and minima of function of two and three variables.

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

- Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
- Find the Eigen values and Eigen vectors
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyse the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions
- Find the extreme values of functions of two variables with/ without constraints.

UNIT-I: Matrices

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; 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 elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors

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

UNIT-III: Sequences & Series

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences.

Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

UNIT-IV: Calculus

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.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-V: Multivariable calculus (Partial Differentiation and applications)

Definitions of Limit and continuity.

Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence & independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

PH102BS: ENGINEERING PHYSICS**B.Tech. I Year I Sem.**

L	T	P	C
3	1	0	4

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- Students will be able to demonstrate competency and understanding of the concepts found in Mechanics, Harmonic Oscillations, Waves in one dimension, wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.
- The main purpose of this course is to equip engineering undergraduates with an understanding of the scientific method, so that they may use the training beneficially in their higher pursuits.
- Today the need is to stress principles rather than specific procedures, to select areas of contemporary interest rather than of past interest, and to condition the student to the atmosphere of change he will encounter during his carrier.

Course outcomes: Upon graduation, the graduates will have:

- The knowledge of Physics relevant to engineering is critical for converting ideas into technology.
- An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
- In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics.
- Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.

UNIT-I: Introduction to Mechanics

Transformation of scalars and vectors under Rotation transformation, Forces in Nature, Newton's laws and its completeness in describing particle motion, Form invariance of Newton's second law, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction, Extension to cylindrical and spherical coordinates.

UNIT-II: Harmonic Oscillations

Mechanical and electrical simple harmonic oscillators, Complex number notation and phasor representation of simple harmonic motion, Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor, Mechanical and electrical oscillators, Mechanical and electrical impedance, Steady state motion of forced damped harmonic oscillator, Power observed by oscillator.

UNIT-III: Waves in one dimension

Transverse wave on a string, The wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Impedance matching, Standing waves and their Eigen frequencies, Longitudinal waves and the wave equations for them, Acoustic waves and speed of sound, Standing sound waves.

UNIT-IV: Wave Optics

Huygen's principle, Superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson's interferometer, Mach-Zehnder interferometer, Fraunhofer diffraction from a single slit and circular aperture, Diffraction grating- resolving power.

UNIT-V: Lasers and Fibre Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO₂) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

TEXT BOOKS:

1. Engineering Mechanics, 2nd ed.- MK Harbola, Cengage Learning
2. I. G. Main, "Vibrations and waves in physics", 3rd Edn, Cambridge University Press, 2018.
3. Ajoy Ghatak, "Optics", McGraw Hill Education, 2012

REFERENCE BOOKS:

1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006
2. O. Svelto, "Principles of Lasers"
3. "Introduction to Mechanics", M.K.Verma, Universities Press

CS103ES/CS203ES: PROGRAMMING FOR PROBLEM SOLVING**B.Tech. I Year I Sem.**

L	T	P	C
3	1	0	4

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes: The student will learn

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into functions and to develop modular reusable code.
- To use arrays, pointers, strings and structures to write C programs.
- Searching and sorting problems.

UNIT - I: Introduction to Programming

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems

Introduction to Algorithms: steps to solve logical and numerical problems. Representation of

Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming

Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments

Bitwise operations: Bitwise AND, OR, XOR and NOT operators

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops

I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr.

Command line arguments

UNIT - II: Arrays, Strings, Structures and Pointers:

Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays

Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings

Structures: Defining structures, initializing structures, unions, Array of structures

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation)

Enumeration data type

UNIT - III: Preprocessor and File handling in C:

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef

Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Function and Dynamic Memory Allocation:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions

Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: Introduction to Algorithms:

Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.

Basic searching in an array of elements (linear and binary search techniques),

Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms),

Basic concept of order of complexity through the example programs

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
2. Hall of India
3. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
4. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
5. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

ME104ES/ME204ES: ENGINEERING GRAPHICS**B.Tech. I Year I Sem.**

L	T	P	C
1	0	4	3

Pre-requisites: Nil**Course objectives:**

- To provide basic concepts in engineering drawing.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

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

- Preparing working drawings to communicate the ideas and information.
- Read, understand and interpret engineering drawings.

UNIT – I

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

UNIT- II

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

UNIT – III

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

UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

UNIT – V

Isometric Projections: 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

Introduction to CAD: (For Internal Evaluation Weightage only):

Introduction to CAD Software Package Commands. - Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

TEXT BOOKS:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

REFERENCE BOOKS:

1. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
2. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

PH105BS: ENGINEERING PHYSICS LAB**B.Tech. I Year I Sem.**

L	T	P	C
0	0	3	1.5

List of Experiments:

1. Melde's experiment:
To determine the frequency of a vibrating bar or tuning fork using Melde's arrangement.
2. Torsional pendulum:
To determine the rigidity modulus of the material of the given wire using torsional pendulum.
3. Newton's rings:
To determine the radius of curvature of the lens by forming Newton's rings.
4. Diffraction grating:
To determine the number of lines per inch of the grating.
5. Dispersive power:
To determine the dispersive power of prism by using spectrometer.
6. Coupled Oscillator:
To determine the spring constant by single coupled oscillator.
7. LCR Circuit:
To determine quality factor and resonant frequency of LCR circuit.
8. LASER:
To study the characteristics of LASER sources.
9. Optical fibre:
To determine the bending losses of Optical fibres.
10. Optical fibre:
To determine the Numerical aperture of a given fibre.

Note: Any 8 experiments are to be performed

CS106ES/CS206ES: PROGRAMMING FOR PROBLEM SOLVING LAB**B.Tech. I Year I Sem.**

L	T	P	C
0	0	3	1.5

[Note: The programs may be executed using any available Open Source/ Freely available IDE

Some of the Tools available are:

CodeLite: <https://codelite.org/>

Code::Blocks: <http://www.codeblocks.org/>

DevCpp : <http://www.bloodshed.net/devcpp.html>

Eclipse: <http://www.eclipse.org>

This list is not exhaustive and is NOT in any order of preference]

Course Objectives: The students will learn the following:

- To work with an IDE to create, edit, compile, run and debug programs
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To Write programs using the Dynamic Memory Allocation concept.
- To create, read from and write to text and binary files

Course Outcomes: The candidate is expected to be able to:

- formulate the algorithms for simple problems
- translate given algorithms to a working and correct program
- correct syntax errors as reported by the compilers
- identify and correct logical errors encountered during execution
- represent and manipulate data with arrays, strings and structures
- use pointers of different types
- create, read and write to and from simple text and binary files
- modularize the code with functions so that they can be reused

Practice sessions:

- a. Write a simple program that prints the results of all the operators available in C (including pre/post increment, bitwise and/or/not, etc.). Read required operand values from standard input.
- b. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values from standard input.

Simple numeric problems:

- a. Write a program to find the max and min from the three numbers.
- b. Write the program for the simple, compound interest.
- c. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.
- d. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:
- e. $5 \times 1 = 5$
- f. $5 \times 2 = 10$
- g. $5 \times 3 = 15$
- h. Write a program that shows the binary equivalent of a given positive number between 0 to 255.

Expression Evaluation:

- a. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula $s = ut + \frac{1}{2}at^2$ where u and a are the initial velocity in m/sec ($= 0$) and acceleration in m/sec^2 ($= 9.8 m/s^2$)).
- b. 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)
- c. Write a program that finds if a given number is a prime number
- d. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
- e. A 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.
- f. Write a C program to generate all the prime numbers between 1 and n , where n is a value supplied by the user.
- g. Write a C program to find the roots of a Quadratic equation.
- h. Write a C program to calculate the following, where x is a fractional value.
- i. $1 - \frac{x}{2} + \frac{x^2}{4} - \frac{x^3}{6}$
- j. Write a C program to read in two numbers, x and n , and then compute the sum of this geometric progression: $1 + x + x^2 + x^3 + \dots + x^n$. For example: if n is 3 and x is 5, then the program computes $1 + 5 + 25 + 125$.

Arrays and Pointers and Functions:

- a. Write a C program to find the minimum, maximum and average in an array of integers.
- b. Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
- c. Write a C program that uses functions to perform the following:
- d. Addition of Two Matrices
- e. ii. Multiplication of Two Matrices
- f. iii. Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not be same.
- g. Write C programs that use both recursive and non-recursive functions
- h. To find the factorial of a given integer.
- i. ii. To find the GCD (greatest common divisor) of two given integers.
- j. iii. To find x^n
- k. Write a program for reading elements using pointer into array and display the values using array.
- l. Write a program for display values reverse order from array using pointer.
- m. Write a program through pointer variable to sum of n elements from array.

Files:

- a. Write a C program to display the contents of a file to standard output device.
- b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
- c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.
- d. Write a C program that does the following:
It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function)
Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function)
The program should then read all 10 values and print them back.

- e. 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).

Strings:

- Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
- Write a C program that converts a number ranging from 1 to 50 to Roman equivalent
- Write a C program that uses functions to perform the following operations:
- 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.
- Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
- Write a C program that displays the position of a character ch in the string S or – 1 if S doesn't contain ch.
- Write a C program to count the lines, words and characters in a given text.

Miscellaneous:

- Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
- Write a C program to construct a pyramid of numbers as follows:

```

1           *           1           1           *
1 2        **          2 3         2 2         **
1 2 3      ***         4 5 6       3 3 3       ***
                                           4 4 4 4      **
                                           *

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Sorting and Searching:

- Write a C program that uses non recursive function to search for a Key value in a given
- list of integers using linear search method.
- Write a C program that uses non recursive function to search for a Key value in a given
- sorted list of integers using binary search method.
- Write a C program that implements the Bubble sort method to sort a given list of
- integers in ascending order.
- Write a C program that sorts the given array of integers using selection sort in descending order
- Write a C program that sorts the given array of integers using insertion sort in ascending order
- Write a C program that sorts a given array of names

Suggested Reference Books for solving the problems:

- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
- Hall of India
- R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
- Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
- Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

MC109ES: ENVIRONMENTAL SCIENCE*B.Tech. I Year I Sem.**

L	T	P	C
3	0	0	0

Course Objectives:

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

Course Outcomes:

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

- 1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha 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.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

MA201BS: MATHEMATICS - II**B.Tech. I Year II Sem.**

L	T	P	C
3	1	0	4

Course Objectives: To learn

- Methods of solving the differential equations of first and higher order.
- Evaluation of multiple integrals and their applications
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals

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

- Identify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real world problems
- Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelopiped
- Evaluate the line, surface and volume integrals and converting them from one to another

UNIT-I: First Order ODE

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II: Ordinary Differential Equations of Higher Order

Second 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 $xV(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallelopiped).

UNIT-IV: Vector Differentiation

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration

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. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

CH102BS/CH202BS: CHEMISTRY**B.Tech. I Year II Sem.**

L	T	P	C
3	1	0	4

Course Objectives:

- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways

Course Outcomes: The basic concepts included in this course will help the student to gain:

- The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
- The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
- The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.
- The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.

UNIT - I:

Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N₂, O₂ and F₂ molecules. π molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d-orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT - II:

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems.

UNIT - III:

Electrochemistry and corrosion: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application. Electroless plating of Nickel.

UNIT - IV:

Stereochemistry, Reaction Mechanism and synthesis of drug molecules: Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation analysis of n-butane.

Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1 , S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydrohalogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT - V:

Spectroscopic techniques and applications: Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

TEXT BOOKS:

1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
4. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.
5. University Chemistry, by B.M. Mahan, Pearson IV Edition.
6. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

ME203ES: ENGINEERING MECHANICS**B.Tech. I Year II Sem.**

L	T	P	C
3	1	0	4

Course Objectives: The objectives of this course are to

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

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

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

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; Static Indeterminacy

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:

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

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 in plane 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. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics & Dynamics

REFERENCE BOOKS:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition, 1983.
2. Andrew Pytel, Jaan Kiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
3. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers", TMH, 2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

ME105ES/ME205ES: ENGINEERING WORKSHOP**B.Tech. I Year II Sem.**

L	T	P	C
1	0	3	2.5

Pre-requisites: Practical skill**Course Objectives:**

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

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

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

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

EN105HS/EN205HS: ENGLISH**B.Tech. I Year II Sem.**

L	T	P	C
2	0	0	2

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. 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 etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

Learning Objectives: The course will help to

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

Course Outcomes: Students should be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT –I

'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II

'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms.

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

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter-**Writing Formal Letters** E.g., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT –III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-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- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places and Events –

Classifying- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension- Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: **Technical Reports-** Introduction – Characteristics of a Report – Categories of Reports

Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

TEXT BOOK:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

REFERENCE BOOKS:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

CH106BS/CH206BS: ENGINEERING CHEMISTRY LAB**B.Tech. I Year II Sem.**

L	T	P	C
0	0	3	1.5

Course Objectives: The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

- Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
- To determine the rate constant of reactions from concentrations as a function of time.
- The measurement of physical properties like adsorption and viscosity.
- To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

Course Outcomes: The experiments will make the student gain skills on:

- Determination of parameters like hardness and chloride content in water.
- Estimation of rate constant of a reaction from concentration – time relationships.
- Determination of physical properties like adsorption and viscosity.
- Calculation of R_f values of some organic molecules by TLC technique.

List of Experiments:

1. Determination of total hardness of water by complexometric method using EDTA
2. Determination of chloride content of water by Argentometry
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe^{2+} by Potentiometry using $KMnO_4$
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate
8. Synthesis of Aspirin and Paracetamol
9. Thin layer chromatography calculation of R_f values. eg ortho and para nitro phenols
10. Determination of acid value of coconut oil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Determination of partition coefficient of acetic acid between n-butanol and water.
14. Determination of surface tension of a give liquid using stalagmometer.

REFERENCE BOOKS:

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's text book of practical organic chemistry 5th edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

**EN107HS/EN207HS: ENGLISH LANGUAGE
AND COMMUNICATION SKILLS LAB**

B.Tech. I Year II Sem.

L T P C
0 0 2 1

The **Language Lab** focuses 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.

Course Objectives:

- ✎ To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- ✎ To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- ✎ To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- ✎ To improve the fluency of students in spoken English and neutralize their mother tongue influence
- ✎ To train students to use language appropriately for public speaking and interviews

Learning Outcomes: Students will be able to attain

- ✎ Better understanding of nuances of English language through audio- visual experience and group activities
- ✎ Neutralization of accent for intelligibility
- ✎ Speaking skills with clarity and confidence which in turn enhances their employability skills

Syllabus

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

- a. **Computer Assisted Language Learning (CALL) Lab**
- b. **Interactive Communication Skills (ICS) Lab**

Listening Skills

Objectives

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
 2. To enable students express themselves fluently and appropriately in social and professional contexts
- Oral practice: Just A Minute (JAM) Sessions

- Describing objects/situations/people
- Role play – Individual/Group activities

➤ **The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, 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 and timesaving in the Lab)**

Exercise – I

CALL Lab:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.

Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.

ICS Lab:

Understand: Communication at Work Place- Spoken vs. Written language.

Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II

CALL Lab:

Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.

ICS Lab:

Understand: Features of Good Conversation – Non-verbal Communication.

Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III

CALL Lab:

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).

Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.

ICS Lab:

Understand: How to make Formal Presentations.

Practice: Formal Presentations.

Exercise – IV

CALL Lab:

Understand: Listening for General Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Public Speaking – Exposure to Structured Talks.

Practice: Making a Short Speech – Extempore.

Exercise – V

CALL Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Interview Skills.

Practice: Mock Interviews.

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 LCD and a projector etc.

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES**B.Tech. II Year I Sem.**

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge at pre-university level**Course Objectives:** To learn

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

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

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
- Taylor's and Laurent's series expansions of complex function.

UNIT - I: Basic Probability**8 L**

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

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

UNIT - II: Probability distributions**10 L**

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

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

UNIT - III: Testing of Hypothesis**10 L**

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

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

UNIT - IV: Complex Variables (Differentiation)**10 L**

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

UNIT - V: Complex Variables (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, Conformal mappings, Mobius transformations and their properties.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.

2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCE BOOKS:

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

MN302ES: FLUID MECHANICS & HYDRAULIC MACHINES**B.Tech. II Year I Sem.**

L	T	P	C
3	1	0	4

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

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

Course Outcomes:

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

ME302ES: MECHANICS OF SOLIDS**B.Tech. II Year I Sem.**

L	T	P	C
3	0	0	3

Course Objectives: The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

This course will advance the students' development of the following broad capabilities:

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

Course Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT - IV

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

- Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses
- Principal stresses and strains – Analytical and graphical solutions.

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

UNIT - V

Torsion of Circular Shafts: Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\theta/L$
– Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

MN304PC: MINE SURVEYING**B.Tech. II Year I Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL

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: Students will get the benefit of fundamentals of surveying knowledge being used for preparation of mine plans. This course gives an opportunity to understand all the techniques of surveying. Students can also get sufficient knowledge on conducting mine surveys using latest instruments and this also provides elementary excursions using total station, GPS, GIS, data generation, preparation of mine plans in the mining industry.

UNIT - I

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

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

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

UNIT - II

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

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

UNIT - III

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

UNIT - IV

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

UNIT - V

Mine Surveys: Verticality of shaft, measurement of depth of shaft. Correlation Survey: classification and purposes of correlation survey; different methods- single shaft (co-plantation method, weissbach triangle method) and two shaft (Weiss quadrilateral method)

Miscellaneous: EDM and modern instruments, open pit surveys, mine plans and sections, Statutory requirements.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN305PC: 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, supporting etc for mines. Modes of entry into the underground mines with special emphasis on various shaft sinking methods for development of mineral deposits are also described.

Course Outcomes:

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

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN306PC: MINE SURVEYING – I LAB**B.Tech. II Year I Sem.**

L	T	P	C
0	0	2	1

Course Objectives:

To familiarize with the various surveying instruments and methods.

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

- Do the range between the two points and measure the distance between two points
- Conduct the chain triangulation survey
- Determine the area by using different methods.
- Determine the elevation of a given point.
- Use the instruments used in the surveying.

LIST OF EXPERIMENTS:

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

AE306ES: MECHANICS OF SOLIDS LAB**B.Tech. II Year I Sem.**

L	T	P	C
0	0	2	1

Pre-Requisites: NIL**Course Objectives:**

- Understand basic knowledge on the mechanical behavior of materials like aluminum, mild steel, and cast iron.
- Adopt with the experimental methods to determine the mechanical properties of materials.

Course Outcomes:

- Identify microstructures and wear properties of engineering materials.
- Examine the defects in the materials by non-destructive testing
- Test the important mechanical properties of ferrous and non-ferrous materials.

List of Experiments:

1. **Brinell Hardness Test:** Determination of Brinell number of a given test specimen.
2. **Rockwell Hardness Test:** Determination of hardness number of different specimens such as steel, brass, copper and aluminum.
3. **Tension Test:** Study the behavior of mild steel and various materials under different loads. To determine
 - a) Tensile
 - b) Yield strength
 - c) Elongation
 - d) Young 's modulus
4. **Torsion Test:** Determine of Modulus of rigidity of various specimens.
5. **Izod Impact Test:** Determination the toughness of the materials like steel, copper, brass and other alloys using Izod test
6. **Charpy Impact Test:** Determine the toughness of the materials like steel, copper, brass and other alloys using Charpy test.
7. **Compression Test on Short Column:** Determine the compressive stress on material.
8. **Compression Test on Long Column:** Determine Young 's modulus of the given long column.
9. **Testing of Springs:** Determine the stiffness of the spring and the Modulus of rigidity of wire material.
10. **Deflection Test For SSB And Cantilever Beam:** Determine the Young's modulus of the given material with the help of deflection of SSB and cantilever beam

REFERENCE BOOKS:

1. Gere, Timoshenko, —Mechanics of MaterialsII, McGraw Hill, 3rd Edition, 1993.
2. R. S Kurmi, Gupta, —Strength of MaterialsII, S. Chand, 24th Edition, 2005.
3. William Nash, —Strength of MaterialsII, Tata McGraw Hill, 4th Edition, 2004.

MN307ES: FLUID MECHANICS & HYDRAULIC MACHINES LAB**B.Tech. II Year I Sem.****L T P C**
0 0 2 1**Pre-Requisites:** NIL**Course Objectives:**

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

Course Outcomes:

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

MC309: CONSTITUTION OF INDIA*B.Tech. II Year I Sem.**

L	T	P	C
3	0	0	0

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

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

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

MN401ES: MINING GEOLOGY**B.Tech. II Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

Course Outcomes:

- Students will gain the skills to identify the geological problems, hazards, and phenomena occurring in the mining practice.
- Students can understand the origin of mineral deposits, techniques of mineral exploration and estimation of mineral resources as outcome of this course.

UNIT - I

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

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

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

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

UNIT - II

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

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

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

UNIT - III

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

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

UNIT - IV

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

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

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

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

UNIT - V

Geology of Tunnels: Purpose, Stand-up time of different rock mass classes, Engineering geological investigations (litho logical, structural, groundwater, geophysical and borehole drilling) to drive tunnels in soft and hard ground, geology of some well-known tunnels of India, problems in tunnelling and their solutions.

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EE401ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**B.Tech. II Year II Sem.**

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To impart the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

UNIT - I:**D.C. CIRCUITS**

Electrical circuit elements (R, L and C), voltage and current sources, KVL & 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**

Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:

P-N JUNCTION AND ZENER DIODE: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

RECTIFIERS AND FILTERS: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π - section Filters.

UNIT - V:

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, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCE BOOKS:

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

MN403PC: MINE MECHANIZATION – I**B.Tech. II Year II Sem.**

L	T	P	C
3	1	0	4

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

UNIT - I

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

UNIT - II

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

UNIT - III

Track Laying: Rail, joints, crossings, plates, turn tables and curves, track extension,
Aerial Ropeways: Types, construction, operation, Applications, advantages and limitations.

UNIT - IV

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

UNIT - V

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

TEXT BOOKS

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

REFERENCE BOOKS:

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

MN404PC: DRILLING AND BLASTING**B.Tech. II Year II Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:**

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

Course Outcomes:

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

UNIT - I

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

UNIT - II

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

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

UNIT - III

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

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

UNIT - IV

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

UNIT - V

Open Pit Blasting: Blasting in opencast mines, blast design, primary and secondary blasting; accidents due to blast in opencast mines and preventive measures; environmental impacts due to blasting- ground vibrations, fly rocks, dust, fumes, water pollution etc. Dimension stone blasting, controlled blasting, computer design of opencast blast; statutory requirements. Introduction to different blasting and fragmentation analysis softwares, blasting economics.

Blasting for Civil Constructions and Trenches: Blasting for road constructions, trench cutting in soft and hard rocks, demolition of buildings, underwater blastings etc. Introduction to blasting instruments like VOD probe, vibration etc. And high speed under cover etc.,

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN405PC: MINE ENVIRONMENTAL ENGINEERING – I**B.Tech. II Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EE409ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB**B.Tech. II Year II Sem.**

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical and Electronics Engineering**Course Objectives:**

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To impart the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

List of experiments/demonstrations:**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 Single-Phase Transformer
(ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS

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

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.

2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan & C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

MN407ES: MINING GEOLOGY LAB**B.Tech. II Year II Sem.**

L	T	P	C
0	0	3	1.5

Pre-Requisites: Mining Geology (Theory)**Course Objectives:**

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

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

1. Identify the properties of rock forming and ore forming minerals.
2. Determine the strike and dip of planar features by Clinometer Compass.
3. Identify the folds, faults and unconformities.
4. Understand the importance and uses of topographic and geological maps in the mining profession
5. Understand the unconfined compressive strength of important rocks.

List of Experiments:

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

Lab Examination Pattern:

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

MN408PC: MINE SURVEYING – II LAB**B.Tech. II Year II Sem.**

L	T	P	C
0	0	3	1.5

Pre-Requisites: NIL**Course Objectives:**

- To familiarize with the various surveying instruments and methods

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

- Conduct the correlation by two shaft co-planar method.
- Conduct the correlation by shaft weisbatch methods and shaft weiss quadrilateral methods.
- Set a curve by ranging offsets from long chord and ranging ranking method.
- Set a curve by Tacheometric and ranging tacheometric methods.

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

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

Text Books/Reference Books:

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

***MC409/*MC309: GENDER SENSITIZATION LAB**
(An Activity-based Course)

B.Tech. II Year II Sem.

L T P C
0 0 2 1

COURSE DESCRIPTION

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality.

This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Objectives of the Course:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Learning Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT - I: UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men
- Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT – II: GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III: GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- “My Mother doesn’t Work.” “Share the Load.”-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. - Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT – IV: GENDER - BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: “*Chupulu*”.

Domestic Violence: Speaking Out Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-“I Fought for my Life....”

UNIT – V: GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks-The Brave Heart.

Note: Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

- **Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on “Gender”.**

- ☞ **ESSENTIAL READING:** The Textbook, “*Towards a World of Equals: A Bilingual Textbook on Gender*” written by A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu published by Telugu Akademi, Telangana Government in 2015.

ASSESSMENT AND GRADING:

- Discussion & Classroom Participation: 20%
- Project/Assignment: 30%
- End Term Exam: 50%

MN501PC: INTRODUCTION TO INDUSTRIAL ENGINEERING**B.Tech. III Year I Sem.**

L	T	P	C
3	0	0	3

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

Course Outcome: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT- I

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

UNIT- II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT- III

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

UNIT- IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN511PE: ENVIRONMENTAL MANAGEMENT IN MINES (Professional Elective – I)**B.Tech. III Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

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

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

UNIT- I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style. Procedure of obtaining environmental clearances for mining Projects.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha 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.

MN512PE: TUNNELING ENGINEERING (Professional Elective – I)**B.Tech. III Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

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

UNIT- I

Introduction to tunneling; geological parameters to be considered for tunneling.
Influence of geological aspects on design & construction of tunnels.
Types of underground excavations.

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN513PE: MINING OF DEEP-SEATED DEPOSITS (Professional Elective – I)**B.Tech. III Year I 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: Future coal production depends on deep seam mining associated with complex geo-mining conditions, and the students in this course gets an opportunity to understand the challenges of deep seam mining alternative methods of safe extraction of coal.

UNIT- I

Exploration: Modern Exploration Techniques to Identify the Complex Coal Deposits. Classification: Classification of Coal Deposits Lying under Typical Geo-mining conditions.

UNIT- II

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.

UNIT- IV

Modern Techniques: Application of Numerical Modeling Techniques to Control Ground Problems of Complex Deposits.

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

REFERENCE BOOKS:

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

MN502PE: MINE ENVIRONMENTAL ENGINEERING – II**B.Tech. III Year I Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:** To introduce causes of mine fires, advances in more lighten technology, explosion causes of, mine inundation etc.**Course Outcomes:** Student can get through knowledge on various issues of mine environmental engineering including assessment and control of hazard due to mine fires, inundations, mine dust etc and can be able to apply the concepts of hazard control measures in the real world mining problems in future**UNIT- I**

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOK:

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

REFERENCE BOOKS:

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

MN503PE: MINE MECHANIZATION - II**B.Tech. III Year I Sem.**

L	T	P	C
3	1	0	4

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 have basic knowledge of installation, commissioning, operation, maintenance and safety aspects of the mining machinery viz., different types of mine winders, man riding systems in underground mines, face machinery like SDL, LHD, Continuous miners, mine pumps and open cast mine machinery like Blast hole drills, shovels, dragline machine, BWE, dumpers etc.

UNIT- I

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

UNIT- II

Winding Drum-types and construction, Safety devices in winders-over speed and over wind preventers, slow braking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft. Numerical problems in different types of winding including Torque – time diagrams.

UNIT- III

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

UNIT- IV

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

UNIT - V

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

TEXT BOOKS:

1. Deshmukh D.J., Vol. I & II Elements of Mining Technology

2. Cherkasky B.M., Pumps & Compressors
3. Walkar winding & Transport

REFERENCE BOOKS:

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

MN504PC: SURFACE MINING TECHNOLOGY**B.Tech. III Year I Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:**

- 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.
- 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 classify and select the suitable surface mining methods and equipment based on site conditions. They will also have a concept of waste dump formations and slope failures in surface mines

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

and stabilisation measures.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN505PC: MINERAL PROCESSING ENGINEERING LAB**B.Tech. III Year I Sem.****L T P C**
0 0 3 1.5**Pre-Requisites:** NIL**Course Objectives:** To study various mineral processing techniques to enrich minerals**Course Outcomes:** At the end of the course, students will be able to

1. Know different sample division techniques.
2. Determine the grinding and crushing characteristics of a given mineral sample.
3. Know the washability characteristic of a coal sample.
4. Determine the moisture content by drying of mineral sample.
5. Determine the average size of samples.

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 sample retained 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 washability characteristic of coal samples using sink-float tests.
9. Study of sedimentation characteristics of a given sample

MN506PC: MINE ENVIRONMENTAL ENGINEERING LAB**B.Tech. III Year I Sem.**

L	T	P	C
0	0	3	1.5

Pre-Requisites: NIL**Course Objectives:**

- 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.

Course Outcomes: The students will get practical knowledge about underground mine ventilation equipment's functions, usage and interpretation of data.

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

1. Detection of mine gases
2. Orsat/Haldane apparatus for gas analysis.
3. Measurement of relative humidity by hygrometer.
4. Kata thermometer.
5. Characteristic curves for fans.
6. Operation of fans in series and parallel.
7. Design of various ventilation devices, Airshaft, Evasese, Doors crossing regulators.
8. Reversal of Ventilation system.
9. Measurement of air quantity by anemometer velometer and smoke tube, pressure survey.
10. Measurement of relative humidity by hygrometer.
11. Study and analysis ventilation network circuit.
12. Study of mine air-conditioning plant.
13. Study of Constructional features of a flame safety lamp and cap lamp,
14. Study of Layout of lamp room.
15. Assessing spontaneous heating susceptibility of coal using DTA/Wet oxidation Apparatus
16. Study of MSA type gas mask i) Filter type apparatus ii) Self Rescue
17. Study of self-contained breathing apparatus i) Drager BG-174 ii) By Travox -120
18. Study of Drager pulmotor (Model: PT-60)
19. Estimation of SPM concentration in air using high volume sampler.
20. Study of construction and working of explosion proof fire stopping.
21. Determination of susceptibility of coal by chemical method or by puff Temperature method.
22. Determination of water quality parameters using water analyzer kit.
23. Determination of flammability temperature of coal by using inflammability index apparatus.
24. Determination of nutrient status in soil using soil test kit.
25. Measurement of Noise level by integrated sound level meter.
26. Measurement of Lux by light meter.
27. Air born dust modeling
28. Air pollution modeling

MN507PC: MINE MECHANIZATION LAB**B.Tech. III Year I 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. Describe the constructional details of various mining equipment.
2. Explain the working of mining machinery.
3. Evaluate the properties of mining machinery.

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

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

MC510: INTELLECTUAL PROPERTY RIGHTS*B.Tech. III Year I Sem.**

L	T	P	C
3	0	0	0

UNIT – I

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

UNIT – II

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

UNIT – III

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

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

UNIT – IV

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

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

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

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

TEXT & REFERENCE BOOKS:

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

MN611PE: 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:**

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

Course Outcome: The students will have basic programming knowledge and its applications on various mining related problems and familiarity with hardware and software issues during development of programs. They will also have a perspective on high-end simulation methodologies and modern techniques to solve mining problems.

UNIT - I

INTRODUCTION TO COMPUTERS: Configuration of computers and servers, evolution of operating systems; Networking Concepts, MIS Concepts – Cloud computing / grid computing in mining, Big Data analytics.

UNIT - II

PROGRAMMING & DBMS CONCEPTS: Algorithm, flow charts and Programming of mining application like pillar design, blast design, subsidence, - Database and Relational database - development of software packages for mining companies – forms, queries and reports, Enterprise resource planning for material managements

UNIT - III

COMPUTERISED MINE PLANNING: Introduction of Geostatistics, Reserve Estimation, kriging, block modelling and orebody modelling, Optimization and mine design, mine scheduling.

UNIT - IV

PROBLEM SOLVING – APPLICATIONS IN MINING: Ventilation network analysis; support design, Applications of CAD in mining, GIS in Mining, online and offline monitoring and control, TDS, FEM and CFD Concepts and basics of modeling and simulation.

UNIT - V

RECENT TRENDS & MINING SOFTWARE: Artificial intelligence, expert system, neural networks, robotics and their applications in mining Functionalities of mine planning software, fragmentation software, and numerical software applicable to mining. Case studies of mining applications

TEXT BOOKS:

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

REFERENCE BOOKS:

1. R.V. Ramani – Editor, APCOM Proceedings Application of Computers and Operations Research in the Mineral Industry, The Society of Mining, Metallurgy and Exploration, Inc., 1996

2. Fytas, K. and Singhal, R.K. Computers Applications in Mineral Industry, A. A. Balkema Publication, 1988.
3. E Balagurusamy , Fundamentals of Computers , Mc Graw Hills Publication, 2009
4. Basandra S K, Computers Today Fourth Edition, Galgotia Publications Pvt. Ltd, 2004

MN612PE: MINERAL PROCESSING (Professional Elective - II)**B.Tech. III Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

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

- Understand the importance of mineral processing technology.
- Understand techniques of mineral processing for concentration of ore minerals economically.
- Review environment friendly techniques for concentration of sulphide minerals.
- Compute the recovery of ore mineral after concentration.

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN613PE: MATERIAL MANAGEMENT IN MINES (Professional Elective - II)**B.Tech. III Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

1. To teach the students on various aspects of materials management like purchasing procedures, and management etc.
2. To teach students on store management and inventory, etc.

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

1. List out the various items to be purchase and procurement methods.
2. Organize the consumption and inventory of materials at regular intervals, etc.
3. Plan store house management for smooth inflow and outflow of the materials.

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:

1. Goplakrishnan, P, and Sundaresan, M. Material Management: An Integrated Approach, Prentice Hall of India Pvt Ltd., New Delhi, 1982.
2. Datta, A.K., Materials Management procedure, Test and cases, Prentice Hall of India Pvt Ltd., New Delhi 1984.

REFERENCE BOOKS:

1. Peckam, H.H., Effective Materials Management, prentice Hall Of India Pvt Ltd., 1984.
2. Prichard, J.W., and Eagle, R.H. Modern Inventory Management, N,Y., Wiley and Breach Science Publishers, 1972.

MN601PC: INTRODUCTION TO INSTRUMENTATION**B.Tech. III Year II Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:** To have a knowledge of

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

Course Outcomes: The knowledge gained on electronic, pressure, flow and vibration measurement will provide a strong platform to understand the concepts on these subjects for further learning.**UNIT I****ELECTRONIC INSTRUMENTS:** CRO - Storage oscilloscope – Digital voltage meter (DVM) – Digital multi meter – XY recorder, Strip chart recorder – Digital recording- Data logger – Introduction to virtual instrumentation.**UNIT II****PRESSURE MEASUREMENTS:** Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges – Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge.**UNIT III****FLOW MEASUREMENTS:** Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rota meter – Mass flow meters.**UNIT IV****VIBRATION, VISCOSITY, HUMIDITY, LEVEL MEASUREMENT:** Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer - Vibrometers – Viscosity – Saybolt viscometer. Humidity – Hot wire electro type hygrometer - Dew cell – Electrolysis type hygrometer.**UNIT V****ANALYSERS:** Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium analyser – Silica analyser – Turbidity meter – Gas analyser – NOx analyser – H2S analyser – CO and CO2 monitor, Dust & Smoke measurement.**TEXT BOOKS:**

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

REFERENCE BOOKS:

1. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
2. Patranabis, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New

Delhi 1999.

3. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 1999.
4. Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994

MN602PC: UNDERGROUND COAL MINING TECHNOLOGY**B.Tech. III Year II Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:**

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

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

UNIT -I

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

UNIT -II

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

UNIT -III

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

UNIT -IV

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

UNIT -V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Singh, T.N. Singh, Underground Winning of Coal – Oxford & IBH Publishing Co. Ltd., 1992.
2. Mathur, S.P., Coal Mining in India, M.S. Enterprises, Bilaspur, 1999.
3. Mathur, S.P., Mining Planning for Coal., M.G. Consultants, Bilaspur, 1993.
4. Szwilski and Richards M.J., Underground Mining Methods and Technology, 1987.
5. [Internet: www.miningindia.com](http://www.miningindia.com)

MN603PC: ROCK MECHANICS ENGINEERING**B.Tech. III Year II Sem.**

L	T	P	C
3	1	0	4

Pre-Requisites: NIL**Course Objectives:**

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

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

UNIT -I

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

UNIT -II

Supports and Supporting: Various methods of roof examination, objectives and limitations of supports, ground forces and in situ stresses, pressure arch theory, evolution of supports, conventional supports-timber and steel supports, arches, yielding supports; rock and cable bolting, shotcreting, roof stitching, support of shaft bottoms, galleries, junctions and places of roof falls, freshly exposed roof supports, longwall powered supports. Design of systematic support rules for B & P and longwall (face and roadways) - development, depillaring, etc.

UNIT -III

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

UNIT -IV

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

UNIT V

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

TEXT BOOKS:

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley and Sons Inc., New York, 1967.
2. Vutukuri, V.S. and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol.I, II, III and IV, Transtech Publication Berlin, 1974/78.
3. Peng S.S., and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992.

REFERENCE BOOKS:

1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
2. Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.
3. Jumkis, A.R. Rock Mechanics, Transtech Publications, Berlin, 1983.
4. [Internet: www.miningindia.com](http://www.miningindia.com)

**MN604PC: GROUND CONTROL & INSTRUMENTATION LAB AND COMPUTER APPLICATIONS
IN MINING LAB**

B.Tech. III Year II Sem.

L T P C
0 0 3 1.5

Pre-Requisites: NIL

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

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

LIST OF EXPERIMENTS:

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

LIST OF EXPERIMENTS:

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

REFERENCE BOOKS:

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

MN605PC: ROCK MECHANICS ENGINEERING LAB**B.Tech. III Year II Sem.****L T P C**
0 0 3 1.5**Pre-Requisites:** NIL**Course Objectives:**

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

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

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

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

EN608HS: ADVANCED COMMUNICATION SKILLS LAB**B.Tech. III Year II Sem.**

L	T	P	C
0	0	2	1

1. Introduction:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

2. Objectives: This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. Syllabus: The following course content to conduct the activities is prescribed for the Advanced Communication Skills (ACS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – letter writing/Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. Minimum Requirement:

The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

5. **Prescribed Lab Manual:** A book titled **A Course Book of Advanced Communication Skills (ACS) Lab** published by Universities Press, Hyderabad.

6. **Suggested Software:** The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE** (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
 - Preparing for being Interviewed
 - Positive Thinking
 - Interviewing Skills
 - Telephone Skills
 - Time Management

7. Books Recommended:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition
3. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
4. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
5. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
6. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
7. English Vocabulary in Use series, Cambridge University Press 2008.
8. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
9. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
10. Job Hunting by Colm Downes, Cambridge University Press 2008.
11. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.

MC609: ENVIRONMENTAL SCIENCE*B.Tech. III Year II Sem.**

L	T	P	C
3	0	0	0

Course Objectives:

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

Course Outcomes:

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

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha 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 PHL 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.

MN711PE: ADVANCED SURFACE MINING (PE - III)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

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

Course Outcomes: The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends 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, and computer assisted hand method. Addition of haulroad on pit plan; Pit layouts. Open-pit optimisation techniques for mine geometry and output, mine development phases, quality control Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system; Feasibility Report, DPR-contents and preparation.

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT V

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

TEXT BOOKS

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

REFERENCE BOOKS:

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

MN712PE: ROCK FRAGMENTATION ENGINEERING (PE - III)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

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

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, drillability of rocks, drilling performance and costs.

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN713PE: RISK ASSESSMENT AND MANAGEMENT (PE - III)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-requisites: Under graduate Physics and Maths.**Course Objectives:** Upon completion of the course, the students shall be able to know the components of safety risk assessment, Epidemiological studies along with safety audit and management in mines**Course Outcomes:** To understand the terminology and reason for preventing accidents, components of Risk Assessment. Apply the Safety Policies, Safety Audit and Safety Management in Mines along with Case studies**UNIT- I**

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN721PE: ROCK SLOPE TECHNOLOGY (PE – IV)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

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

Course Outcome: The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters

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

REFERENCE BOOKS:

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

MN722PE: MINE SYSTEMS ENGINEERING (PE – IV)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

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

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

UNIT- I

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

UNIT- II

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

UNIT- III

Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines
Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN723PE: DIMENSIONAL STONE TECHNOLOGY (PE – IV)**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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. Students get a benefit of detailed understanding of various techniques of dimensional stone mining including diamond wire saw, blind cut technique etc. Also get the benefit of processing techniques such as gang saws, automatic tiling plant, multiwire machine for slab making etc. and environmental impact due to mining and processing activities.

UNIT- I

Resources of Marble, Granite, Slate, Sandstone and Limestone as Dimensional stones in India vis a vis 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

In situ 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 BOOK:

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

REFERENCE BOOKS:

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

MN701PC: UNDERGROUND METAL MINING TECHNOLOGY**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

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

Course Outcomes: The students will have basic concept on metal mining methods, mine design, development and operations of metal mines. They will also know about novel methods of metal 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. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Hustrulid, W.A. Ed., Underground Mining Methods Handbook Society of Mining Engineering AMIE, New York, 1990.

REFERENCE BOOKS:

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

MN702PC: MINE LEGISLATION**B.Tech. IV Year I Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

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

UNIT- I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT - V

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

TEXT BOOKS

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

REFERENCE BOOKS:

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

MN811PE: MINE PLANNING AND DESIGN (PE - V)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

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

Course Outcomes: The students will have knowledge on planning of opencast mining, underground mining and equipment utilization. They will also know about project implementation and monitoring methods.

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

UNIT - III

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

UNIT - IV

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

UNIT V

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

TEXT BOOKS:

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

REFERENCE BOOKS

1. Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.
2. Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.
3. Christopher J. Bise, Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy, and Exploration, 2003.
4. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.

MN812PE: GEO-STATISTICS (PE - V)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To introduce and differentiate the classical statistics and geostatistics for precise resource evaluation, reserve calculations and ore body modelling as important components of mining operations.

Course Outcomes: Students understand the procedures for sampling, estimation reserves of mineral resources and ore body modelling using geostatistics as outcome of this course, which is highly beneficial for the mining engineers for mine planning and development of mine.

UNIT- I

Introduction to geostatistics and statistical estimates using population and samples; Concept of Random variables; Probability and Lognormal distribution. Basics of Geostatistics: Regionalised variable and data analyses.

UNIT- II

Semi-variogram and variance estimation: Calculation of experimental semi-variograms; Mathematical models of semi-variogram and application in mineral exploration. Extension, Estimation Variance and Dispersion variance

UNIT- III

Introduction to Kriging: Linear, Ordinary and Simple kriging; Solving kriging system of equations for Point and Block Kriged Estimates and Kriging Variance with some examples number of samples. nugget effect. Influence of Nugget effect on kriging weights; Properties of kriging.

UNIT- IV

Geostatistical evaluation of mineral deposits, orebody modelling, calculation of mineral resource inventory, grade-tonnage relationships, role of kriging variance in optimization of exploration drilling and misclassified tonnages.

UNIT- V

Basics of Geostatistical Conditional Simulation.

TEXT BOOKS:

1. Geostatistics with Applications in Earth Sciences- D D Sharma-Springer
2. Multivariate Geo-statistics: An Introduction with Applications- Hans Wackernagel-Springer

REFERENCE BOOKS:

1. Solved Problems in Geo-statistics- Oy Leuangthong , K. Daniel Khan, Clayton V. Deutsch-Wiley
2. Mineral Resource Estimation- Mario E. Rossi, Clayton V. Deutsch-Springer

MN813PE: ROCK EXCAVATION ENGINEERING (PE - V)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

Course Outcomes: The students will have knowledge about mechanism of rock excavation process, influences of rock properties in excavation, rock cutting technology and types of excavating 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 drillability and cuttability 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. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987.

REFERENCE BOOKS:

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

MN821PE: MINE ECONOMICS (PE - VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL**Course Objectives:**

- Study of estimation and valuation of mineral deposits
- Study of project appraisal
- Study of finance and accounting

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

UNIT - I

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

UNIT - II

Ore Reserve Estimation: Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, introduction to geo-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, etc.; assets; liabilities; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MN822PE: MINERAL EXPLORATION (PE - VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

Course Outcomes: Students can understand the procedures for exploration of mineral deposits, estimation of mineral resources as outcome of this course, which is highly beneficial for the mining engineers in the industry.

UNIT - I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Sharma, N L and Agarwal Y K. Tables for Mineral Identification.
2. A.M. Evans. 1997: Ore Geology and Industrial minerals- An introduction (III edn.) Geo- science, Texas.

MN823PE: MINE SUBSIDENCE ENGINEERING (PE - VI)**B.Tech. IV Year II Sem.**

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

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

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

UNIT- I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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