JNTUH COLLEGE OF ENGINEERING

VISION
To be recognized as one of the top 10 institutes in the country offering technical education, sustaining and improving its repute of UG programmes, expanding need based PG and research programmes with global outlook, synergising teaching and research for societal relevance

MISSION
1. To identify technological advancements and build the right level of skills at the right time contributing to the industrial and national growth.
2. To identify and keep abreast with the state of the art technology maintaining its legacy of striving for excellence in higher education.
3. To promote world class research of local relevance to society.
4. With a research community of professors, research fellows and research centres, expand the scale and multidisciplinary character of its research activities.
5. With a global outlook strive for collaborations to network with International Universities and National Institutes of Research and Higher Learning.
METALLURGICAL ENGINEERING DEPARTMENT

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

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

Program Educational Objectives (Metallurgical Engineering)
The Metallurgical Engineering program at JNTUH-CEH prepares graduates who can

PEO 1
Obtain good and high positions in public or private institutions as engineers and researchers.

PEO 2
Follow higher education in prestigious universities and have a successful academic career.

PEO 3
Demonstrate advancement in their chosen career by upgrading their skills continuously.

PEO 4
Exhibit high ethical standards and responsibilities towards their profession and society.

Program Outcomes (Metallurgical Engineering)

<table>
<thead>
<tr>
<th>PO 1</th>
<th>Engineering Knowledge: Knowledge of mathematics, science, and engineering fundamentals and ability to apply them to solve complex metallurgical phenomena.</th>
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<tr>
<td>PO 2</td>
<td>Problem Analysis: Identification and analysis of process - structure – property – performance correlation of metals and materials with the knowledge of science and engineering principles.</td>
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<td>PO 3</td>
<td>Design/Development of solutions: Ability to design material systems, components, process to meet the desired needs within the realistic constraints of economic, public safety, environmental, manufacturability, and sustainability.</td>
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<tr>
<td>PO 4</td>
<td>Conduct Investigations of Complex problems: Design, conduct, analyze, and interpret the results of tests and researches in the field of metallurgical engineering and propose appropriate measures for efficient capacity utilization of systems; components and equipment etc. with minimum energy and rejects.</td>
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</table>
**Program Specific Outcomes (Metallurgical Engineering)**

**PSO 1**
Apply metallurgical principles to provide ecological and cost effective solutions for metal extraction and refining industries and manufacturing industries.

**PSO 2**
Identify, evaluate and modify existing materials and their behaviour with respect to structure – property – processing – performance applications and develop new materials that are sustainable, economical and eco-friendly with tailor made properties and applications.

**PSO 3**
Understand, evaluate, modify and design existing manufacturing processes, characterization techniques and develop new processes to specific engineering applications and ensure reliable and sustainable products.
## JNTUH COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)

B.TECH. FOUR YEAR DEGREE COURSE
(METALLURGICAL ENGINEERING)

COURSE STRUCTURE

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## III YEAR

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During Summer Vacation between III and IV Years: Industry Oriented Mini Project
# Course Structure

## IV Year

### I Semester

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Professional Elective – I
  i) Fuels, Furnaces & Refractories
  ii) Nanomaterials
  iii) Computational Materials Engineering

Professional Elective – II
  i) Advanced Iron and Steel Making
  ii) Composite Materials
  iii) Electronic Materials

Professional Elective – III
  i) Light Metals & Alloys
  ii) Fatigue and Fracture Mechanics
  iii) Failure Analysis

Professional Elective – IV
  i) Surface Engineering
  ii) Energy Materials
  iii) Non Destructive Testing

Professional Elective – V
  i) Solidification Processing
  ii) Non Metallic Materials
  iii) Functional Materials

Professional Elective – VI
  i) Powder Metallurgy
  ii) Bio Materials
  iii) Transport Phenomena

Open Elective - I
  i) Engineering Materials
  ii) Metallurgy for Non Metallurgists

Open Elective – II
  i) Corrosion Process and Control
  ii) Testing of Materials

Open Elective – III
  i) Alloy Steels
  ii) High Temperature Materials
Pre-requisites: Mathematical Knowledge of 12th/Intermediate level

Course Objectives: To learn
1. Types of matrices and their properties.
2. Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
3. Concept of Eigenvalues and Eigenvectors and to reduce the quadratic form to canonical form.
4. Concept of Sequence.
5. Concept of nature of the series.
6. Geometrical approach to the mean value theorems and their application to the mathematical problems.
7. Evaluation of surface areas and volumes of revolutions of curves.
8. Evaluation of improper integrals using Beta and Gamma functions.
10. Finding maxima and minima of function of two and three variables.

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: Eigenvalues and Eigenvectors
Linear Transformation and Orthogonal Transformation: Eigenvalues 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

References

Course outcomes:
After learning the contents of this paper the student must be able to
1. Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
2. Find the Eigenvalues and Eigenvectors
3. Reduce the quadratic form to canonical form using orthogonal transformations.
4. Analyse the nature of sequence and series.
5. Solve the applications on the mean value theorems.
6. Evaluate the improper integrals using Beta and Gamma functions
7. Find the extreme values of functions of two variables with/ without constraints.
ENGINEERING PHYSICS

I Year B.Tech. I-Sem

Prerequisites : Nil

Course Objectives :
The course should enable the students to:
1. Understand the concepts of interference and diffraction.
2. Learn the basic principles of laser and optical fiber.
3. Know about band theory and the classification of materials into three groups.
4. Exposed to present generation engineered materials and their properties.
5. Have knowledge about principles of wave mechanics.

UNIT-I: Wave Optics
Introduction, Huygen’s principle, Superposition of waves, Interference of light by wave front splitting-
Young’s double slit experiment, amplitude splitting- Newton’s rings, Fresnel and Fraunhofer diffractions,
Fraunhofer diffraction at a single slit and double slit, Diffraction grating: Grating spectrum and resolving
power, Introduction to polarization, Double refraction - Construction & working principle of Nicol prism.

UNIT-II: Lasers and Fibre Optics
Lasers: Introduction, Absorption, Spontaneous and Stimulated emission of radiation, Characteristics of
Lasers, Active medium, Resonating cavity, Pumping mechanisms, Population inversion, Einstein
coefficients and relation between them, Construction and working of lasers: Ruby laser, He-Ne laser and
application of lasers.

aperture, Types of Fibres - Single & Multimode, Glass & Plastic, Step Index & Graded Index Optical
fibers, Losses associated with optical fibres, Basic components in optical fiber communication system,
Applications of optical fibres.

UNIT-III: Introduction to solids
Introduction, Free electron theory of metals, Classical and quantum free electron theory, Estimation of
Fermi energy, Dependence of Fermi level on temperature, Density of states, Bloch’s theorem, Kronig –
Penny model, E-K diagram, Origin of energy bands, Classification of materials on the basis of energy
bands, Direct and Indirect band gaps, Effective mass of electron.

UNIT-IV: Synthesis & Characterization of Nanomaterials
Introduction, nanoscale, Quantum confinement, Surface to volume ratio, Bottom-up Fabrication: Sol-Gel,
Precipitation, Combustion Methods; Top-Down Fabrication: Chemical Vapor Deposition, Physical Vapor
Deposition, Characterization Techniques (XRD, SEM &TEM) and Applications of nanomaterials.
UNIT-V: Ultrasonics & Acoustics of Buildings

Ultrasonics: Introduction, Production of ultrasonic waves, Magnetostriction method, Piezoelectric method, Detection of ultrasonic waves, Properties of ultrasonic waves, Use of ultrasonics for non-destructive testing, Applications of ultrasonics.

Acoustics of buildings: Introduction, Basic requirements of acoustically good hall, Reverberation and time of reverberation, Sabine’s formula for reverberation time, Measurement of absorption coefficient of a material, Factors affecting the architectural acoustics and their remedies, Acoustic quieting.

Text Books:
1. A textbook of Engineering Physics, Dr. M.N. Avadhanulu, Dr. P. G Kshirsagar – S. Chand
2. Haliday and Resnick, Physics – Wiley

References:
2. Introduction to Solid State Physics by Charles Kittel, Wiley student edition
3. O. Svelto, “Principles of Lasers”.

Course Outcomes:
The student will be able to:
1. Analyze and get knowledge about diffraction grating and polarization.
2. Justify applications and principles of laser and how the graded index optical fiber is more efficient than step index optical fiber in fiber optic communication system.
3. Gain clear knowledge about Fermi level and energy band diagram.
4. Get clear knowledge about fabrication and characterization of nanomaterials.
5. Learn about Principles and applications of ultrasonic waves and acoustics of buildings.
PROGRAMMING FOR PROBLEM SOLVING

I Year B.Tech. I-Semester

Prerequisites: Nil

Course objectives:
1. To learn the fundamentals of computers.
2. To understand the various steps in Program development.
3. To learn the syntax and semantics of C Programming Language.
4. To learn the usage of structured programming approach in solving problems.

UNIT – I


Introduction to C Language: Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output, Operators. Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Bit wise operators, Statements, Simple C Programming examples.

UNIT – II

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

Designing Structured Programs: Functions, basics, user defined functions, inter function communication, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Preprocessor commands, example C programs

UNIT – III

Arrays and Strings: Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays, C program examples. Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

UNIT – IV

Pointers: Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions, command –line arguments.

Input and Output: Concept of a file, streams, standard input / output functions, formatted input / output functions, text files and binary files, file input / output operations, file status functions (error handling), C program examples.
UNIT – V
Derived types: Structures – Declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit fields, enumerated types, C programming examples.
Sorting and Searching: Selection sort, Bubble sort, Insertion sort, Linear search and Binary search methods.

Text Books:
3. The C Programming Language by B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

Reference Books:
3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

Course Outcomes:
The student will learn
1. To write algorithms and to draw flowcharts for solving problems.
2. To translate the algorithms/flowcharts to programs (in C language).
3. To code and test a given logic in C programming language.
4. To formulate simple algorithms for arithmetic and logical problems.
5. To decompose a problem into functions and to develop modular reusable code.
6. To use arrays, pointers, strings and structures to formulate algorithms and programs.
7. Searching and sorting problems.
ENGINEERING GRAPHICS

I Year B.Tech. I-Sem

Pre-requisites: Nil

Course objectives:
1. To provide basic concepts in engineering drawing
2. To impart knowledge about standard principles of orthographic projection of objects
3. To draw sectional views and pictorial views of solids

UNIT–I
INTRODUCTION TO ENGINEERING DRAWING:

UNIT–II
ORTHOGRAPHIC PROJECTIONS:

UNIT–III
Projections of Regular Solids – Auxiliary Views.

UNIT–IV
Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere. Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone

UNIT–V
ISOMETRIC PROJECTIONS:

Text Books:
1. Engineering Drawing by N.D. Bhatt, Charotar
Reference Books:
1. A Text Book of Engineering Drawing by Dhawan R K, S. Chand

Course Outcomes:
At the end of the course, the student will be able to:
1. Prepare working drawings to communicate the ideas and information.
2. Read, understand and interpret engineering drawings.
ENGINEERING PHYSICS LAB

I Year B.Tech. I-Sem

Pre-requisites: Engineering Physics

Course Objectives:
1. To help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
2. To introduce the concepts and techniques which have a wide application in experimental science, but have not been introduced in the standard courses.
3. To teach how to write a technical report which communicates scientific information in a clear and concise manner.

LIST OF EXPERIMENTS
1. Melde’s experiment: To determine the frequency of tuning fork.
2. Torsional pendulum: To determine the rigidity modulus of the material of a given wire.
3. Newton’s rings: To determine the radius of curvature of a plano-convex lens by forming Newton’s rings.
4. Diffraction grating: To determine the wavelength of a given source.
5. Dispersive power: To determine the dispersive power of a prism by using spectrometer.
6. Coupled Oscillator: To determine the spring constant by single coupled oscillator.
7. LCR Circuit: To determine the resonant frequency and quality factor of LCR circuit.
8. LASER: To study the L-I & P-I characteristics of LASER sources.
9. Losses in optical fibre: To determine the bending losses of optical fibres.
10. Optical fibre: To determine the numerical aperture of a given fibre.
11. Sonometer: To determine the frequency of AC mains.
12. Stewart – Gee’s experiment: Determination of magnetic field along the axis of a current carrying coil.

Note: Any 8 experiments are to be performed by each student

Learning Outcomes:

By the end of the course students will be able:
1. To make careful experimental observations and draw conclusions from such data.
2. To distinguish between inferences based on theory and the outcomes of experiments.
3. To write a technical report which communicates scientific information in a clear and concise manner.
PROGRAMMING FOR PROBLEM SOLVING LAB

I Year B.Tech. I-Sem

Pre-requisites: Programming for Problem Solving

Course Objectives:
1. To learn the fundamentals of computers.
2. To understand the various steps in Program development.
3. To learn the syntax and semantics of C Programming Language.
4. To learn the usage of structured programming approach in solving problems.

Week 1:
1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
3. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a C program to find the roots of a quadratic equation.

Week 2:
5. Write a C program to find the factorial of a given integer.
6. Write a C program to find the GCD (greatest common divisor) of two given integers.
7. Write a C program to solve Towers of Hanoi problem.
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Week 3:
9. Write a C program to find both the largest and smallest number in a list of integers.
10. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices
    ii) Multiplication of Two Matrices

Week 4:
11. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn’t contain T.
14. Write a C program to count the lines, words and characters in a given text.
Week 5:
15. Write a C program to generate Pascal’s triangle.
16. Write a C program to construct a pyramid of numbers.
17. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: \(1 + x + x^2 + x^3 + \ldots + x^n\)
   For example: if n is 3 and x is 5, then the program computes 1+5+25+125.
   Print x, n, the sum
   Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.

Week 6:
18. 2’s complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2’s complement of 11100 is 00100. Write a C program to find the 2’s complement of a binary number.
19. Write a C program to convert a Roman numeral to its decimal equivalent.

Week 7:
20. Write a C program that uses functions to perform the following operations:
   i) Reading a complex number
   ii) Writing a complex number
   iii) Addition of two complex numbers
   iv) Multiplication of two complex numbers
   (Note: represent complex number using a structure.)

Week 8:
21. i) Write a C program which copies one file to another.
   ii) Write a C program to reverse the first n characters in a file.
      (Note: The file name and n are specified on the command line.)
22. i) Write a C program to display the contents of a file.
   ii) Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

Week 9:
23. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order
   i) Bubble sort   ii) Selection sort   iii) Insertion sort

Week 10:
24. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:
   i) Linear search   ii) Binary search
Text Books:
3. The C Programming Language by B.W. Kernighan and Dennis M. Ritchie, PHI, Pearson Education

Reference Books:
3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

Course Outcomes:
The student will learn
1. To write algorithms and to draw flowcharts for solving problems.
2. To translate the algorithms/flowcharts to programs (in C language).
3. To code and test a given logic in C programming language.
4. To formulate simple algorithms for arithmetic and logical problems.
5. To decompose a problem into functions and to develop modular reusable code.
6. To use arrays, pointers, strings and structures to formulate algorithms and programs.
7. Searching and sorting problems.
Pre-requisites: Mathematical Knowledge of 12th/Intermediate level

Course Objectives: To learn
1. Methods of solving the differential equations of first and higher order.
2. Evaluation of multiple integrals and their applications
3. The physical quantities involved in engineering field related to vector valued functions
4. The basic properties of vector valued functions and their applications to line, surface and volume integrals

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 $x V(x)$; 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 parallel piped).

UNIT-IV: Vector Differentiation

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

Text Books
Reference Books

Course outcomes:
After learning the contents of this paper the student must be able to
1. Identify whether the given differential equation of first order is exact or not
2. Solve higher differential equation and apply the concept of differential equation to real world problems
3. Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and gravity for cubes, sphere and rectangular parallel piped
4. Evaluate the line, surface and volume integrals and converting them from one to another
ENGINEERING CHEMISTRY

I Year B.Tech. II-Sem

L T P C
3 1 0 4

Pre-requisites: Nil

Course Objectives:
1. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
4. To acquire the skills pertaining to spectroscopy and to apply them for medical field etc.
5. To impart then knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.

Unit-1: 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 NO molecules. Bond order.


Unit-2: Water and its treatment:


Unit-3: Electrochemistry and corrosion:

Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Unit-4: Stereochemistry, Reaction Mechanism and synthesis of drug molecules:
Representation of 3-dimensional structures, Isomers-Structural and stereoisomers, Enantiomers, diastereomers, symmetry and chirality. optical activity Absolute configuration. Conformational analysis of n- butane.


Unit-5: Spectroscopic techniques and applications:

Text Books:

Reference Books:
1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan
4. Fundamentals of Molecular Spectroscopy, by C.N. Banwell

Course Outcomes:
The basic concepts included in this course will help the student to gain:
1. The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
2. The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
3. The required skills to get clear concepts on basic spectroscopy and application to medical field etc.
4. The knowledge and configurational and conformational analysis of molecules and reaction mechanisms.
ENGINEERING MECHANICS

I Year B.Tech. II-Sem

L T P C
3 1 0 4

Pre-Requisites: NIL

Course Objectives:
During this course, students should develop the ability to:
1. Work comfortably with basic engineering mechanics concepts required for analyzing static structures
2. Identify an appropriate structural system to studying a given problem and isolate it from its environment.
3. Model the problem using good free-body diagrams and accurate equilibrium equations
4. Identify and model various types of loading and support conditions that act on structural systems.
5. Apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem.
6. Understand the meaning of centers of gravity (mass)/centroids and moments of Inertia using integration methods.
7. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.

UNIT – I: INTRODUCTION OF ENGINEERING MECHANICS

UNIT – II: FRICTION

UNIT – III: CENTROID AND CENTER OF GRAVITY

MOMENT OF INERTIA: Moment of Inertia of Areas and Masses - Transfer Formula for Moments of Inertia - Moment of inertia of composite areas and masses.

UNIT – IV: KINEMATICS
Introduction – Rectilinear motion – Motion with uniform and variable acceleration – Curvilinear motion – Components of motion – Circular motion – Projectiles- Instantaneous centre.

UNIT – V: KINETICS
Textbooks:

References:
1. Engineering Mechanics (Statics and Dynamics) by Hibbler; Pearson Education.
5. A textbook of engineering mechanics by R. K. Bansal; Laxmi publications.

Course Outcomes:
At the end of the course, the student will be able to:
1. Solve problems dealing with forces in a plane or in space and equivalent force systems.
2. Solve beam and cable problems and understand distributed force systems.
3. Solve friction problems and determine moments of Inertia and centroid using integration methods.
4. Understand and know how to solve three-dimension force and moment problems.
5. Understand and know how to use vector terminology.
I Year B.Tech. II-Sem

Pre-Requisites: Nil

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 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 in the areas of Vocabulary, Grammar, Reading and Writing Skills, fostering ideas and practice of language skills in various contexts.

Learning Objectives
The course will help students to
a. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
b. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
c. Develop study skills and communication skills in formal and informal situations.

SYLLABUS
(Note: As the syllabus of English given in AICTE Model Curriculum-2018 for B.Tech First Year is Open-ended, 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 class.)

Unit –I
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.

Unit –II
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.


Unit –III
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: Writing Introduction and Conclusion - Essay Writing.

Unit –IV
Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension- Intensive Reading and Extensive Reading.

Writing: Writing Practices—Précis Writing.

Unit –V
Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice


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

References:
(iii) English: Context and Culture by Board of Editors published by Orient BlackSwan Pvt. Ltd.

Course Outcomes
Students should be able to
1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. The student will acquire basic proficiency in English including reading and listening comprehension, writing, and speaking skills.
ENGINEERING CHEMISTRY LAB

I Year B.Tech. II-Sem

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Pre-Requisites: Engineering Chemistry

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

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

List of Experiments:

1. Determination of total hardness of water by complexometric method using EDTA
2. Estimation of Fe^{2+} by Dichrometry.
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 Coconut oil and ground nut oil by using Ostwald’s viscometer.
14. Determination of partition coefficient of acetic acid between n-butanol and water.

References

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)

Course Outcomes:
The experiments included in the chemistry laboratory will make the student to gain the skills on

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

I Year B.Tech. II-Sem

Pre-requisites: Practical skill

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

I. TRADES FOR EXERCISES:
(Any six trades from the following with minimum of two exercises in each trade)
1. Carpentry – 2 Lectures
2. Fitting- 1 Lecture
3. Tin-Smithy-1 Lecture
4. Black Smithy-1 Lecture
5. House-wiring-1 Lecture
6. Foundry- 2 Lectures
7. Plumbing-1 Lecture

II. Trades for Demonstration & Exposure
1. Demonstration of power tools -1 Lecture
2. Welding – 2 Lecture
3. Machine Shop-2 Lectures

III. IT Workshop I: Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, simple diagnostic exercises.
   IT Workshop II: Installation of operating system windows and Linux simple diagnostic exercises.

Text Books:
1. Workshop Practice by B.L.Juneja Cengage Learning
Course Outcomes:
At the end of the course, the student will be able to:
1. Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
2. Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
3. Apply basic electrical engineering knowledge for house wiring practice.
ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

I Year B.Tech. II-Sem

L T P C
0 0 2 1

Pre-requisites: English
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.

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

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

Exercise – II
CALL Lab:
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:

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:
1. Introduction to Interview Skills.
2. Common errors in speaking.

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.

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
ENGINEERING MATHEMATICS-III
(Probability Distributions and Complex Variables)

II Year B.Tech. I-Sem

Pre-Requisites: Mathematics courses of first year of study.
Course Objectives: To learn
1. The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
2. The basic ideas of statistics including measures of central tendency, correlation and regression.
3. The statistical methods of studying data samples.
4. Differentiation and integration of complex valued functions.
5. Evaluation of integrals using Cauchy’s integral formula and Cauchy’s residue theorem.

UNIT-I: Basic Probability
Probability spaces, conditional probability, independent events, and Bayes’ theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT-II: Probability distributions
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: Estimation & Tests of Hypotheses

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

UNIT-V: Complex Variables (Integration)
Line integral, Cauchy’s theorem, Cauchy’s Integral formula, Zeros of analytic functions, Singularities, Taylor’s series, Laurent’s series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties (All theorems without Proofs)
Text Books

Reference Books

Course Outcomes:
After learning the contents of this paper the student must be able to
1. Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
2. Analyse the complex function with reference to their analyticity, integration using Cauchy’s integral and residue theorems
3. Taylor’s and Laurent’s series expansions of complex function
MINERAL DRESSING

II Year B.Tech. I-Sem

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Pre-Requisites: Nil

Course Objectives:
1. Introduce students to the principles of ore comminution, liberation and particle size analysis and the different equipments used in the processes.
2. Teach the students about various the methods of concentration/ separation and the processes suitable to the liberated ore equipments used.
3. Acquaint the students about quantifying concentration processes and selection of proper mineral dressing cycles for an ore/mineral.

UNIT–I

UNIT–II

UNIT–III

UNIT–IV
Tabling- Basic principle, study of stratification on a table, Wilfred Table. Humphrey’s spiral classifier. Basic principles of Magnetic separation processes and electrostatic separation process. Brief description about the working of belt and drum magnetic separator, high tension separator.

UNIT–V
Text Books:

References Books:
1. Elements of Ore Dressing by A.F. Taggart.
2. Ore dressing practices - S. K. Jain.

Course Outcomes:
At the end of the course the student will be able to:
1. Recognition of the need of the mineral dressing prior to extraction of metals.
2. Describe the working and construction details of various equipments used in mineral dressing.
3. Assess the efficiency of concentration processes.
4. Select and describe a particular concentration process suitable to the liberated ore.
5. To make a logical link between mineral processing and economics of metal production.
6. Apply the knowledge learned so as to being capable of understanding advance courses in mineral processing operations and modeling.
PHYSICAL METALLURGY

II Year B.Tech. I-Sem

Pre-Requisites: Engineering Physics & Engineering Chemistry

Course Objectives:
1. Give basic concepts of material science.
2. The prime objective of this course is to make the student gain an understanding of the relation between microstructural characteristics and properties of metals and alloys.
3. The course also critically focuses on the crystallography, phase transformations that occur in several ferrous and nonferrous metallurgical systems as a function of temperature and composition through phase equilibrium diagrams.

UNIT–I
Structure of Metals, Types of Chemical bonding, Crystal systems, plane and directional indices, transformation of indices, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitial voids.

UNIT–II
Microscopy: Metallurgical Microscope, principles and construction, types of objectives and eyepieces, common defects of lenses, Introduction to electron Microscopy-Principle and operation of SEM, TEM.

UNIT–III
Strengthening mechanisms: solid solution strengthening, work hardening, precipitation hardening and dispersion strengthening.

UNIT–IV
Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, phase rule, Types of Phase diagrams: Binary Isomorphous alloy systems, non- equilibrium cooling, binary eutectic system, peritectic and monotectic reactions. Phase diagrams with intermediate phases and compounds. Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, miscibility gaps.

UNIT–V
Transformation in solid state: allotropy, eutectoid, peritectoid reactions and order-disorder transformations. Study of important binary phase diagrams: Fe-Fe₃C, Cu-Zn, Cu-Sn, Pb-Sn, Al-Cu and complex phase diagrams.

Text Books:
Reference Books:
1. Physical Metallurgy Principles- R.E. Reed Hill.
3. Physical Metallurgy - Vijendra Singh
5. Metallurgy for Engineers- Clark and Varney.

Course Outcomes:
At the end of the course the student will be able to:
1. Analyze the structure of crystalline materials and calculate the various crystals parameters.
2. Explain the working of metallurgical microscope and its different parts.
3. Explain the necessity of alloys, will identify the different types of alloy phases.
4. Explain the construction and identification of phase diagrams and reactions.
5. Explain the Fe-Fe3C diagram with invariant reactions.
6. Explain the Cu-Zn and other binary diagrams and complex phase diagrams etc.
THERMODYNAMICS AND KINETICS

II Year B.Tech. I-Sem

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Pre-Requisites: Nil

Course Objectives:
1. The prime aim of this course is to apply thermodynamics and kinetics to various metallurgical aspects like Solutions, Phase diagrams, Diffusion, and Ellingham Diagrams.
2. The course is also intended to correlate electrochemical principles with thermodynamics.
3. To provide a consistent picture of thermodynamic concepts when applied to various topics.

UNIT-I
Objectives and limitations to thermodynamics, concepts of system and state, heterogeneous and homogeneous systems, extensive and intensive properties of system, thermodynamic variables, thermodynamic equilibrium and Zero\textsuperscript{th} law of thermodynamics. Reversible and irreversible processes.

UNIT-II
First Law of thermodynamics: Relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, Heat capacity, reversible adiabatic processes, reversible isothermal pressure or volume changes, of an ideal gas, Joules experiment, Joule-Thompson experiment, Joule-Thompson co-efficient, Enthalpy change with temperature, Kirchhoff’s equation. Efficiency of a cyclic process, Carnot cycle, Carnot theorem, Second law of thermodynamics, concept of entropy, Quantification of irreversibility.

UNIT-III
Free energy functions: Purposes of the new functions, definition of Helmholtz and Gibbs free energy change, meaning of thermodynamically possible process, determination of $\Delta G$ from thermal data, useful relationships between free energies and other thermodynamic functions, Maxwell’s equations and Gibbs-Helmholtz equation.
Third law of thermodynamics: Background of third law, deductions from third law, applications of third law, other methods of obtaining $\Delta S^0$ for a reaction.

UNIT-IV
Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature, Tabular methods recording, thermodynamic data, sigma functions.
Claussius – Clapeyron equation: Introduction, derivation of the Claussius – Clapeyron equation for single substance, Duhring rule for the estimation of the vapour pressures of an element, Integration of Claussius – Clapeyron equation.

UNIT-V
Kinetics: Kinetics of chemical process, Molecularity and order of a reaction, zero order reactions, first order, second order reactions, Determination of order of reaction, collision theory, theory of absolute reaction rates, consecutives and simultaneous reactions, catalysis in chemical reactions.
Text Books:
1. Introduction to Metallurgical Thermodynamics – D.R. Gaskell.
2. Chemical and Metallurgical Thermodynamics- M.L. Kapoor.

Reference Books:
1. Physical chemistry for Metallurgists – J. Mackowiak.
3. Physical chemistry of metals- L.S. Darken & Gurry.

Course Outcomes:
At the end of the course the student would be able to:
1. Knowledge of the type of variable that affects heterogeneous reaction rates nucleation, interfacial energy, interface equilibrium and diffusion.
2. Relate 1st and 2nd Law of thermodynamics.
3. Knowledge of enthalpy, entropy and free energy.
4. Understand the principles of kinetics and thermodynamics as applied to rates and equilibrium positions of chemical reactions.
5. Calculate the temperature dependence of rate constants and relate this calculation to activity and fugacity.
6. Determine order of reaction. Explain the central concepts of chemical kinetics. Formulate and solve rate equations for various reactions.
METALLURGICAL ANALYSIS

II Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. To know the principles of qualitative and quantitative analysis of ores, metals, alloys, and refractory materials.
2. To know the principles and working of the various instruments utilized in instrumental analysis.
3. To know the importance of metallurgical analysis in the field of metallurgy.

UNIT-I
Importance of chemical analysis, scope of metallurgical analysis, classification of various methods used in metallurgical analysis. Solution preparations: Normality, Molarity, Molality, Equivalent weight. Dissolution of ores in general, metals and alloys.

UNIT-II
Chemical Analysis - Basic Principles - theory of indicators – Conventional solution methods for qualitative analysis of ores, fluxes, slags, metals and refractories. Qualitative analysis of common non-ferrous alloys such as brasses, bronzes and solders. Estimation of C, S, Si, Mn and P in cast iron and steel.

UNIT-III
Estimation of Cr, Ni, Mo, W and V in alloy steels. Determination of iron in iron ore, manganese in manganese ores, lime in limestone, fire-assay of precious metals.

UNIT-IV
Instrumental analysis: Importance of instrumental analysis – Comparison with standard wet chemical methods - Fundamental Physicochemical principles involved and equipment required in absorptiometry i.e, colorimetry and spectrophotometry, colorimetric titrations.

UNIT-V
Spectroscopy, potentiometry, amperometric titrations, Calorimetric titrations, polarography conductometry, electro - analysis and flame photometry.

Text Books:
Reference Books:

Course Outcomes:
At the end of the course the student will be able to:
1. Know the importance of chemical analysis and its fundamentals. Also know how it is related to metallurgical engineering.
2. Distinguish between qualitative and quantitative measurements and compare them. Can also suggest a method for analyzing different materials.
3. Interpret and identify the elements through analysis, and can explain about analysis of precious metals through assaying.
4. Understand the theoretical principles behind modern analytical instrumentation. Apply theory and operational principles of analytical instruments. Select and apply appropriate instrumental methods of analysis to problems in any of the sciences.
5. Develop a range of knowledge relating to instrument operation, observation, measurement and interpretation of results. Convert between wavelength, energy and frequency for light and understand the relationship between absorbed light and color.
6. Assess and choose different methods to identify the nature of the material given.
MINERAL DRESSING LAB

II Year B.Tech. I-Sem

Pre- Requisites: Mineral Dressing

Course Objectives:
This laboratory course is designed to
1. Make the student to learn and demonstrate the usage of crushers and grinders.
2. Learn to conduct concentration methods at laboratory scale.
3. Teach the students how to note down the observations and results obtained in the experiments.

List of Experiments:
1. Sampling of an ore from the bulk by
   (i) Coning and quartering method.
   (ii) Riffle sampler.
2. Determination of average particle size of a given material by sieve analysis.
3. Verification of Stoke’s Law.
4. Size reduction of the given material using Jaw Crusher and determining the reduction ratio.
5. Size reduction of the given material using Roll Crusher and determining the reduction ratio.
6. Size reduction of the given material using Ball Mill and determining the reduction ratio.
7. Determine the grindability index of coal using hard groove grindability machine.
8. Separation of the given material into magnetic and non magnetic particles using magnetic separator.
10. Determination of recovery percentage of the concentrate by Froth- Floatation process.

Course Outcomes:
At the end of the laboratory course the student will be able to:
1. Pick or take a representative amount of sample and conduct sieve analysis.
2. Determine the reduction ratio in crushing and grinding of different materials using various types of size reduction units.
3. Analyze the grindability of different coals.
4. Separate or concentrate the given materials using magnetic separation and froth flotation processes.
5. Prepare formal laboratory reports.
METALLOGRAPHY LAB

II Year B.Tech. I-Sem

Pre-Requisites: Physical Metallurgy

Course Objectives:
The laboratory course helps to:
1. Gain skills of preparation of samples for metallographic examinations.
2. Find and analyze the microstructures of various ferrous and non ferrous materials.
3. Use the suitable metallurgical microscope with suitable magnification.

List of Experiments:
1. Preparation and study of Crystal models.
2. Study of various microscopes (Optical microscope, SEM, TEM) and specimen preparation techniques for metallurgical microscope.
5. Metallographic preparation and microstructure evaluation of high carbon steel.
6. Metallographic preparation and microstructure evaluation of different cast irons (grey cast iron, white cast iron, malleable cast iron, spheroidal graphite iron).
7. Metallographic preparation and microstructure evaluation of Copper.
10. Drawing of the Binary phase diagrams of Isomorphous, simple Eutectic and partial solubility diagram with interpretation.
11. Drawing of complex binary phase diagrams and identification of points, lines and areas in them.
12. Experiments to obtain cooling curves for pure metals and alloys and to establish Binary phase diagram.

Course Outcomes:
By completing this laboratory course, students:
1. Can describe the metallurgical microscope, sample preparation, mounting and use/choosing of different etching reagents.
2. Can identify and report the microstructural features of ferrous and non ferrous samples observed.
3. Can operate optical microscope with an ease.
4. Characterize microstructures of engineering alloys using optical microscopy and image analyzer.
5. Prepare formal laboratory reports.
METALLURGICAL ANALYSIS LAB

II Year B.Tech. I-Sem

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Pre- Requisites: Metallurgical Analysis

Course Objectives:
1. This course introduces chemical analysis of metallic alloys using laboratory practice.
2. This course gives knowledge on principles and working of various instruments used in analysis.

List of Experiments:
2. Estimation of Iron in Iron ore by K₂Cr₂O₇ method.
3. Estimation of lime in Limestone.
5. Estimation of manganese in cast iron.
7. Estimation of Chromium in Steel.
10. Estimation of the concentration of KMnO₄ in the solution using Digital Spectrophotometer.

Course Outcomes:
At the end of this laboratory course, the student will be able to:
1. Identify the major elements in a metallic alloy using chemical methods.
2. Quantify specific elements in ferrous and non-ferrous alloys using titration.
3. Identify certain elements in salts by flame photometry.
4. Interpret the results from different spectroscopy instruments to determine chemical composition.
5. Learn operating techniques of different instruments used in analysis.
6. Prepare formal laboratory reports.
ENVIRONMENTAL SCIENCE

II Year B.Tech. I-Sem

Pre-Requisites: NIL

Course Objectives:
1. Creating the awareness about environmental problems among students.
2. Imparting basic knowledge about the environment and its allied problems.
3. Developing an attitude of concern for the environment.
4. Motivating students to participate in environment protection and environment improvement.

UNIT- I:

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:
Definition, Scope and Importance - Need for Public Awareness.

NATURAL RESOURCES : Renewable and non-renewable resources - Natural resources and associated problems - Forest resources - Use and over - exploitation, deforestation, case studies - Timber extraction - Mining, dams and other effects on forest and tribal people - Water resources - Use and over utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT - II


UNIT - III

UNIT - IV
ENVIRONMENTAL POLLUTION AND CONTROL:
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.

UNIT - V


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

Reference Books:
1. Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.

Course Outcomes:
At the end of the course, it is expected that students will be able to:
1. Identify and analyze environmental problems as well as the risks associated with these problems
2. Understand what it is to be a steward in the environment.
3. Studying how to live their lives in a more sustainable manner.
BASIC ELECTRICAL ENGINEERING

II Year B.Tech. II-Sem

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Pre- Requisites: Nil

Course Objectives:
1. To introduce the concepts of electrical circuits and its components.
2. To understand magnetic circuits, DC circuits and AC single phase & three phase circuits.
3. To study and understand the different types of DC/AC machines and Transformers.
4. To import the knowledge of various electrical installations.
5. To introduce the concept of power, power factor and its improvement.

UNIT-I
Time-domain analysis of first - order RL and RC circuits.

UNIT-II
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 consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit.
Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

UNIT-IV

UNIT-V
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.

Text Books:
Reference Books:

Course Outcomes:
1. To analyze and solve electrical circuits using network laws and theorems.
2. To understand and analyze basic Electric and Magnetic circuits.
3. To study the working principles of Electrical Machines.
4. To introduce components of Low Voltage Electrical Installations.
BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

II Year B.Tech. II-Sem L T P C

3 0 0 3

Pre- Requisites: Nil

Course Objectives:
To prepare engineering students to analyze cost/ revenue/ financial data and to make economic and financial analysis in decision making process and to examine the performance of companies engaged in engineering.


UNIT- III: Production, Cost, Market Structures & Pricing:

Unit- IV: Capital Budgeting Techniques: Significance of Capital Budgeting - cash flows-Time Value of Money- Choosing between alternative investment proposals- Methods of Appraisal Techniques- Pay Back Period - Average Rate of Return – Net Present Value- Internal Rate of Return – Profitability Index.


Suggested Readings:
Course Outcomes:
To perform and evaluate present and future worth of the alternate projects and to appraise projects by using traditional and DCF Methods. To carry out cost benefit analysis of projects and to calculate BEP of different alternative projects.
HEAT TREATMENT AND PHASE TRANSFORMATIONS

II Year B.Tech. II-Sem

Pre-Requisites: Physical Metallurgy

Course Objectives:
1. This course is mainly designed to impart knowledge about basic principles and process variables of different heat treatment processes.
2. Thermo mechanical treatment, Surface hardening techniques, heat treatment of steels, cast irons, non ferrous alloys will also be dealt in detail.
3. Identification of heat treatment defects and related knowledge of heat treatment furnaces will also be dealt in detail.

UNIT-I

UNIT-II

UNIT-III

UNIT–IV
Heat-Treatment of Cast Irons, Cu and its alloys and Al and its alloys.

UNIT-V
Heat treatment furnaces, Atmospheres and their design, Heat treatment defects.

Text Books:

Reference Books:
1. Heat Treatment of Metals by Vijendra Singh
4. Physical Metallurgy Principles - Reed Hill.
Course Outcomes:
At the end of the course the student will be able to:
1. Apply and interpret phase and continuous cooling diagrams information to assess the impact of a range of heat treatment procedures.
2. Demonstrate a critical understanding of the importance of heat treatment in achieving fit for purpose in metals and alloys.
3. Learn the fundamentals of microstructure modifications through thermo mechanical and surface heat treatment processes to achieve the desired properties.
4. Propose suitable heat treatment procedures for non ferrous metals like Cu, Al etc.
5. Identify and give reasons for the heat treatment defects and explain the various heat treatment furnaces and atmospheres.
6. Correlate the microstructure properties, processing and performance of alloys.
PRINCIPLES OF EXTRACTIVE METALLURGY

II Year B.Tech. II-Sem

Pre-Requisites: Mineral Dressing and Thermodynamics and Kinetics

Course Objectives:
1. To learn and emphasize the principles of pyrometallurgy, hydrometallurgy and electrometallurgy.
2. To learn scientific concepts of extraction and refining.
3. Obtain knowledge of equipment used in pyrometallurgy, hydrometallurgy and electrometallurgy.
4. Gain basic knowledge about pelletisation and Sintering.

UNIT-I

UNIT-II
Slags: Classification, properties, Application of Ellingham diagrams for oxides and sulphides.

UNIT-III
Hydrometallurgy: Flowchart, Principles and types of leaching, Advantages and limitations, Solution purification by ion and solvent exchange methods, Metal recovery from leach solution by cementation.

UNIT-IV
Classification of electrometallurgy, Principles of electrometallurgy, Advantages and limitations of electrometallurgy, Electro winning and Electro refining with typical examples.

UNIT-V
Principles of Refining: Fire refining, Distillation, liqation, electro-refining and zone refining with some examples.

Text Books:

Reference Books:
Course Outcomes:
At the end of the course the student will be able to:
1. Classify the different ores and describe the various units operating like pyro metallurgy, hydrometallurgy and electrometallurgy.
2. Differentiate the various types of slags, properties and their applications.
3. Illustrate with the help of flow sheet of process taking place in pyro metallurgy, hydrometallurgy and electrometallurgical extractions of metal/matte.
4. Choose the type of refining process according purity required.
5. Understand the impact of extractive process on health environment society and will be able to suggest suitable techniques to recycle the byproducts or to decrease energy consumptions.
6. Design the suitable process for extraction.
METALLURGICAL THERMODYNAMICS

II Year B.Tech. II-Sem

Pre-Requisites: Nil

Course Objectives:
This course is mainly intended to deals with
1. The laws of diffusion.
2. Interpret Ellingham diagrams
3. Identify metallurgical thermodynamics principles to be applied in phase diagrams.

UNIT-I
Diffusion: Fick's laws of diffusion and its applications, Kirkendall effect, Darken's equations, the Matano Method. Determination of intrinsic diffusivities, self diffusion in pure metals, Temperature dependence of the diffusion coefficient, diffusion along the grain boundaries and surfaces.

UNIT-II
Ellingham Diagrams: Introduction, calculation of equilibrium constants from standard free energy changes, general description of Ellingham diagrams, Interpretation of free energy changes Vs. temperature lines, Richardson's diagrams.

UNIT-III
Thermal Properties: Specific heats of solids, classical, Einstein and Debye's models of the lattice. Anharmonicity, thermal expansion, thermal conductivity of solids, lattice thermal conductivity and thermo-electric effects. Stability of crystal disorders.

UNIT-IV
Solutions: Solution definition, Composition, partial molal quantities, ideal solutions, Raoult's Law, actual (Nonideal) solutions, Sievert's law, Gibbs - Duhem equation, integration of Gibbs - Duhem equation, Excess thermodynamics quantities. Application to phase diagrams: Concept of chemical potential, equality of chemical potentials in equilibrated phases, Derivation of Gibbs phase rule, solidus and liquidus lines for an ideal solution, calculation of liquidus line for eutectic systems.

UNIT-V
Reversible Cells: Electro- Chemical cells, galvanic cells, chemical and electrical energy, thermodynamics of Electro-chemical cells, standard electrode potentials, sign convention of electrode potentials, application of Gibbs - Helmholtz equation to galvanic cells. Concentration Cells.

Text Books:
1. Physical Chemistry for Metallurgist by J. Mackowick.
2. Physical Chemistry of Metals by LS Darken and Gurry.
Reference Books:
1. Thermodynamics of solids by RA Swalin.
2. Physical Metallurgy Principles by RH Reed Hill.
3. Material science; A First course by Raghavan.

Course Outcomes:
Obtain the skill to use Metallurgical Thermodynamics concept for
1. Understand and able to use Fick’s I and II law.
2. Interpret Ellingham Diagram for oxides.
3. Understand the thermal properties of solids, specifically, specific heat and some models for specific heat calculation.
5. Apply the phase rule on the metallurgical systems.
6. Understanding of the nature of polarized electrochemical reactions and an introduction of their application in corrosion behavior of metals.
BASIC ELECTRICAL ENGINEERING LAB

II Year B.Tech. II-Sem

Pre-Requisites: Basic Electrical Engineering

Course Objectives:
1. To analyze a given network by applying various electrical laws and network theorems
2. To know the response of electrical circuits for different excitations
3. To calculate, measure and know the relation between basic electrical parameters.
4. To analyze the performance characteristics of DC and AC electrical machines

List of Experiments/Demonstrations:
1. Verification of Ohms Law.
2. Verification of KVL and KCL.
3. Transient Response of Series RL and RC circuits for DC excitation.
4. Transient Response of RLC Series circuit for DC excitation.
5. Resonance in series RLC circuit.
8. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation).
9. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star).

- Any ten experiments will be conducted from the above list

Course Outcomes:
1. Get an exposure to basic electrical laws.
2. Understand the response of different types of electrical circuits to different excitations.
3. Understand the measurement, calculation and relation between the basic electrical parameters
4. Understand the basic characteristics of transformers and electrical machines.
PRINCIPLES OF EXTRACTIVE METALLURGY LAB

II Year B.Tech. II-Sem L T P C

Pre-Requisites: Principles of Extractive Metallurgy

Course Objectives:
1. This course is designed to give knowledge about different types of extraction processes.
2. Know the Importance of EMF series.

List of Experiments
1. Important flow sheets for Metal Extraction.
2. Electro Cleaning of a given material by using electrolysis principle.
3. Electro Etching of a given material by using electrolytic cell.
4. Electro polishing of a given material by using electrolytic cell.
5. Importance of EMF series.
6. Calculate cathode current efficiency electro plating of Copper.
7. Calculate cathode current efficiency electroplating of Nickel.
8. Galvanization of Zinc on mild steel.
9. Electro winning of Copper by using aqueous electrolyte.
10. Electro winning of Copper by using prepared electrolyte from raw materials.

Course Outcomes:
1. To study the importance of EMF series.
2. Understand different types of electro cleaning, electro etching, electro polishing techniques.
3. Study the concepts of metal extraction processes.
4. To calculate cathode current efficiency of electroplating of metals.
5. To perform electrowinning of Cu by different electrolytes.
6. To perform galvanisation of Zinc
HEAT TREATMENT AND PHASE TRANSFORMATIONS LAB

II Year B.Tech. II-Sem

Pre-Requisites: Heat Treatment and Phase Transformations

Course Objectives:
This course is mainly designed to
1. To conduct various heat treatment processes, surface hardening techniques and age hardening processes on different materials.
2. Gain knowledge of phase transformations taking place under various conditions of heat treatment.

List of Experiments:
1. Annealing of plain carbon steel and observation of microstructure.
3. Hardening of plain carbon steel with quenching in water and brine solution and observation of microstructures.
4. Hardening of plain carbon steel with quenching in oil and observation of microstructure.
5. Effect of tempering temperature on plain carbon steel.
7. Age hardening of Aluminium alloy or Copper alloy.
8. Spheroidizing of a given high carbon steel.
11. Determination of phase fraction and grain size using Image analyzer.

Course Outcomes:
At the end of the course the student will be able to:
1. Conduct heat treatment in furnaces under suitable/ required time, temperature and atmospheric conditions.
2. Modify the microstructures of metals and alloys through heat treatment practice for obtaining desired properties in present and future.
3. To modify the surface properties of steels.
4. To determine hardenability by performing Jominy end quench test
5. Analyze, correlate and interpret the results obtained in the tests conducted.
6. Report the observations in a formal manner.
MANAGEMENT FUNDAMENTALS FOR ENGINEERS

III Year B.Tech. I -Sem

Pre-requisites: Nil

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

Unit –I
Introduction to Management: Evolution of Management, Nature & Scope-Functions of Management-Role of Manager - levels of Management-Managerial Skills - Challenges-Planning-Planning Process-Types of Plans - MBO

Unit–II
Organization Structure & HRM: Organization Design-Organizational Structure-Departmentation--Delegation-Centralization - Decentralization-Recentralization-Organizational Culture - Organizational climate - Organizational change


Unit –III

Unit-IV

Unit-V
Suggested Readings:

Course Outcomes:
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.
FUELS, FURNACES & REFRACTORIES
(Professional Elective – I)

Pre-Requisites: Nil

Course Objectives:
1. Relate the properties and applications of solid, liquid and gaseous fuels.
2. Broad knowledge on modes of heat transfer.
3. Describe the different types of refractories and pyrometers and their properties and uses.
4. Have a basic knowledge on working of different types of furnaces.

UNIT–I
Liquid fuels: Properties and applications.

UNIT –II
Manufacture, properties and uses of Producer gas and Water gas.

UNIT-III

UNIT-IV
Pyrometry: Thermo electric pyrometer - Peltier and Thomson e.m.f. Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f. by Milli-voltmeter and potentiometer. Principle, operation and applications of Thermometer, Optical and Radiation pyrometers.

UNIT – V
Refractories: Classification and desirable properties of refractories, modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite, Dolomite, Chromite and Carbon refractories. Testing of Refractories, Applications of refractories in the metallurgical industries.
Text Books:

Reference Books:
1. Elements of fuel technology – HIMUS.
2. Furnaces - J. D. Gilchrist.
5. Elements of thermodynamics & heat transfer - Obert & Young.

Course Outcomes:
At the end of the course the student would be able to:
1. Know about a fuel, classify them and compare different types of fuels and describe their testing methods. Explain the coke making process, list out the properties and its by-products recovery and suggest methods for decreasing environmental pollution and energy consumption.
2. Apply principles of heat and mass transfer to basic engineering systems and understand the basic concepts and laws of the three modes of heat transfer and apply analytical techniques to the solution of conduction heat-transfer problems.
3. Classify and explain construction and working of different furnaces. Analyze the causes of heat losses in furnaces and suggest methods of minimization of heat loss and waste heat recovery.
4. Describe the operation of a thermocouple. Describe various temperature-measuring devices - thermometers and pyrometers. Discuss the principles that govern noncontact thermal measurements and describe the operation of optical and radiation pyrometers.
5. Explain various manufacturing and testing processes of refractories. Itemize many examples of metallurgical refractories under different categories, their main properties and applications. Link inherent properties of the refractory mineral and how it affects the production technology and the application.
6. Select the relevant fuel, furnace and refractory material for the metallurgical operations and can justify the interpretation.
NANO MATERIALS
(Professional Elective – I)

III Year B.Tech. I-Sem

Pre-Requisites: Engineering Physics and Engineering Chemistry

Course Objectives:
1. This course is primarily intended to expose the students to a highly interdisciplinary subject.
2. This would emphasize on the classification, synthesis and applications of Nano materials.
3. To enhance the various nano synthesis techniques and to identify and solve problems.
4. To describe methods for production of nano materials and their characterization techniques for applications of nano materials.

UNIT-I

UNIT-II
Zero Dimensional Nano-structures, Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic Nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.

UNIT-III

UNIT-IV

UNIT-V
Thin films, Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films. Special Nano Materials, Carbon fullerene and nano tubes: carbon fullerenes, formation, properties and applications. Carbon nano tubes: formation and applications.

Text Books:
2. Nano Essentials: T. Pradeep, TMH.
Reference Books:
1. Springer Handbook of Nanotechnology.
2. The Guest for new materials Author S. T. Lakshmi Kumar, Published by Vigyan Prasar.

Course Outcomes:
At the end of the course the student would be able to:
1. Describe the importance and impact of nanomaterials and their diversified applications, listing out their salient properties and uses in commercial and industrial applications.
2. Describe the various types of nano materials used in semi conductors, ferro electric devices etc.
3. Can illustrate and categorize the synthesis procedures and characterization techniques with respect to nano particles
4. Can illustrate and categorize the synthesis procedures and characterization techniques in case of nano tubes and nano wires.
5. Describe the various types of thin film deposition techniques and differentiate their merits and demerits.
6. Demonstrate the capacity and exhibit interest for self-directed learning on topics related to nanoscience and nanotechnology.
COMPUTATIONAL MATERIALS ENGINEERING  
(Professional Elective – I) 

III Year B.Tech. I-Sem 

Pre-Requisites: Nil 

Course objective: 
1. This course introduces computational methods in the domain of metallurgical engineering. 
2. To understand the structure property correlations in materials engineering. 
3. To understand evolution of materials structure and to control material properties. 
4. To calculate the miscellaneous problems by using computational techniques. 

UNIT- I 
Introduction, Tools of the trade: a short tutorial introduction: 

UNIT-II 

UNIT- III 

UNIT-IV 

UNIT-V 
Text Books:

Reference Books:

Course Outcomes:
At the end of the course the student should be able to:
1. Analyse a metallurgical problem to create a well posed numerical problem.
2. Identify initial and boundary conditions of a problem relevant to materials domain.
3. Propose a solution procedure for a numerical problem in the domain of materials engineering.
4. Demonstrate ability to quantify a materials engineering problem through numerical analysis.
5. Select materials for specific applications and also to design advanced materials for new applications.
6. To use preferred tools at electronic, continuum and structural levels.
MECHANICAL METALLURGY

III Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. To gain an understanding of the response of various metals under the application of stress and/or temperature.
2. To build necessary theoretical background of the role of lattice defects in governing both elastic and plastic properties of metals will be discussed.
3. Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.
4. Obtain a working knowledge of creep and fatigue and analysis of data.

UNIT-I

UNIT-II
Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell, Shore and Poldi methods, Microhardness test, relationship between hardness and other mechanical properties.

The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve, metallurgical factors affecting on transition temperature, temper embrittlement.

UNIT-III

Fracture: Elementary theories of fracture, Griffith’s theory of brittle fracture, ductile fracture, notch sensitivity. Strain-Energy release rate, Stress Intensity Factor, Fracture Toughness and design, $K_{IC}$ Plane-Strain Toughness testing, plasticity corrections, J-Integral.

UNIT-IV

UNIT-V
Creep and Stress Rupture: Introduction, The creep curve, Stress-rupture test, structural changes during creep, mechanism of creep deformation, theories of creep. Fracture at elevated temperature, effect of metallurgical variables on creep.
Text Books:

Reference Books:
2. Mechanical behavior - Ed. Wulf.

Course Outcomes:
At the end of the course the student will be able to:
1. Interpret the effect of crystalline defects on the behavior of metals.
2. Can conduct hardness, Impact test and interpret COD, CTOD and DBTT diagrams.
3. Determine the appropriate test for analysis of tensile and compression properties of materials.
4. Can design creep and fatigue resistant materials.
5. Assess and describe the mechanism leading failure of a given material.
6. Solve numerical problems and gain of knowledge of how to incorporate material strength limitation into engineering design.
IRON MAKING AND STEEL MAKING TECHNOLOGIES

III Year B.Tech. I-Sem

Pre-Requisites: Mineral Dressing, Thermodynamics and Kinetics and Principles of Extractive Metallurgy

Course Objectives:
1. To provide the knowledge of Iron making by Blast Furnace, Physico-chemical principles involved in iron making.
2. To provide knowledge of the various types of steel making processes, and the importance of slag and its control mechanisms.
3. Explain and describe the importance of modern steel making processes.

UNIT-I
Raw materials for Iron making, Preparation of iron ores; Agglomeration of Iron ore fines: Sintering - Purpose and Principle, Factors affecting sintering, sintering bonds; Pelletisation - Purpose and Principle, Production of green pellets, Induration of pellets.

UNIT-II
Iron making through blast furnace route, Blast Furnace profile and its design, refractory lining, blast furnace cooling system, raw materials handling and charging. Construction and operation of Hot blast stoves. Gas cleaning system and its utilization.

UNIT-III
Physical chemistry of Iron making, Blast furnace reactions, Physical and chemical factors affecting reduction of ores; Effect of temperature, CO/CO$_2$ and H$_2$/H$_2$O on reduction of iron ore. Control of C, Si, S, P in pig iron. Blast furnace operations and difficulties, modern trends in blast furnace.

UNIT-IV

UNIT-V

Text Books:
Reference Books:
1. Basic Thermodynamics and Kinetics, Alain Vignes (ISTE Ltd.,).
2. Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,).
3. Processing Operations and Routes, Alain Vignes (ISTE Ltd.,).

Course Outcomes:
At the end of this course the student will be able to:
1. Describe the raw materials and agglomeration techniques for production of pig iron in the blast furnace.
2. Illustrate and describe the blast furnace and its auxiliary equipments, analyse the physical and chemical processes taking place in blast furnace and factors influencing the quality of the blast furnace product.
3. Analyse the irregularities and causes of failures in blast furnace and apply remedial measures for immediate rectification and relate the modern trends to improved productivity and quality.
4. Explain the principles of steel making process and describe the various production techniques for quality steel making.
5. Explain the conventional/ingot casting practice in steel making, auxiliary units and their importance in casting and the various cast structures obtained and their control mechanism.
6. Able to undertake any technical assignment in R&D and production units with professional responsibility towards profession and society.
MATERIALS PROCESSING – I

III Year B.Tech. I-Sem

L T P C
4 0 0 4

Pre-Requisites: Nil

Course Objectives:
1. This course is mainly intended to introduce and explain various moulding, casting techniques and equipment used.
2. Principles of Solidification of casting, defects in castings and their remedies are also dealt in detail.
3. This course also provides in depth knowledge about various metal joining techniques, the thermal and residual stresses associated with, the equipment used, their modern developments, and defects of weldments.

UNIT- I
Introduction to Foundry – Types of Foundries, Patterns: Materials for patterns, types of patterns; functions and pattern allowance. Moulding materials; moulding sands, properties and selection of materials and additives.
Moulding Processes: Green and dry sand moulding; shell moulding, CO₂ moulding. Core making. Gating, Risering and their design.

UNIT-II
Casting Methods: Permanent mould casting, pressure die-casting, Gravity die casting, Vacuum die casting, centrifugal casting, Investment Casting, Squeeze casting and Composite Casting, Casting defects arising due to moulding, cores, melting and pouring practice.

UNIT- III

UNIT- IV

UNIT-V

Text Books:
Reference Books:

Course Outcomes:
1. Determine moulding sand dry, hot and green strength.
2. Understand the preparation of moulding sand.
3. Determine moulding sand properties by varying additives.
4. Understand the Melting of Al alloys.
5. Gain hands on experience in various methods of welding and joining of metals and understand the mechanical behavior of the joint with respect to microstructure and mechanical properties.
6. Understand the causes of welding defects and how they can be prevented.
MECHANICAL METALLURGY LAB

III Year B.Tech. I-Sem

Pre-Requisites: Mechanical Metallurgy

Course Objectives:
Students will be able:
1. Demonstrate skill in using different hardness testing machines.
2. Explain the rationale for using particular loads in testing hardness and tensile properties of materials.
3. Knowledge of the standard specimens dimensions and determining toughness of materials by impact test.
4. Become aware of working principle and use of various Non Destructive Tests.

List of Experiments:
1. Determine the hardness of ferrous and non-ferrous samples using Brinell hardness.
2. Determine the hardness of ferrous and non-ferrous samples using Rockwell hardness.
3. Tension test:
   a. Determine the Tensile properties of ductile ferrous materials.
   b. Determine the Tensile properties of ductile non-ferrous materials.
4. Determine the Compression properties of brittle materials.
5. To determine the Toughness of the given material by Charpy and Izod (V & U Groove notch).
6. Determination the variation of formability of the given various thickness materials by Erichson cupping test.
7. Liquid penetrant Test: To detect the surface flaws in a given materials by dye penetrant.
8. To detect the surface flaws in steel by fluorescent penetrant method.
9. Magnetic flaw detector: To inspect a given material for cracks.
10. Ultrasonic flaw detection: To inspect a given material for locating cracks.

Course Outcomes:
After completing the course, the student will be able:
1. Explain the methods of destructive testing (Hardness testing, Tensile testing, Impact and cupping tests) and non destructive testing (LPT, MPT and UT).
2. Analyze, interpret and present the observation from the tests conducted.
3. Identify the reasons for failure through Non Destructive Examination.
4. Can prepare formal laboratory reports describing the experimental and the results obtained.
5. Solve material problems associated by proper testing.
MATERIALS PROCESSING LAB - I

III Year B.Tech. I-Sem  L  T  P  C
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Pre-Requisites: Materials Processing - I

Course Objectives:
1. This lab course is designed to provide hands on experience on various foundry testing methods for evaluation of moulding sand properties.
2. It also designed to make the student to understand and demonstrate the various types of welding processes and its variables.
3. Understand and apply the principles of metal casting process and develop relation between input and output parameters.
4. To study the various modes of metal transfer that exists in welding processes.

List of Experiments:
1. Preparation of gating system using green sand moulding.
2. Study of particle size distribution of the sand.
3. Study of permeability of green sand with clay and water.
4. Determination of sand properties: green and dry strength, green and dry hardness, hot shear strength with variation in sand additives.
5. Determination of clay content in sand.
6. Determination of moisture content in sand.
7. Determination of the shatter index of green sand.
8. Melting of Al alloys in a pit furnace and casting into light components.
9. Preparation of a butt joint with mild steel plates using Arc welding process and study the comparison of the bead geometry with DCSP, DCRP and A.C.
10. Demonstration and practice of resistance spot welding process and plot the variation of spot area with time and current variation.
11. Preparation of a butt joint with mild steel strip using Tungsten Inert Gas (TIG) welding process.
12. Preparation of a butt joint with mild steel plate using MIG welding process.
13. Evaluation of Microstructure of welded joint and observe the structural difference in Weld zone, Heat Affected Zone and Base metal.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Determine moulding sand dry, hot and green strength.
2. Understand the preparation of moulding sand.
3. Determine moulding sand properties by varying additives.
4. Understand the Melting of Al alloys.
5. Gain hands on experience in various methods of welding and joining of metals and understand the mechanical behaviour of the joint with respect to microstructure and mechanical properties.
6. Understand the causes of welding defects and how they can be prevented.
FUELS LAB

III Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:

This laboratory course deals with:

1. Analysis of fuels and their importance.
2. Characterization of refractories.
3. Use different types of fuel testing equipment.

List of Experiments:

1. Proximate analysis of Coal (percentage of moisture, volatile matter, ash content & Fixed Carbon).
2. Ultimate analysis of Coal (Carbon, hydrogen, sulfur and oxygen).
3. Determination of Flash and Fire points of diesel using PENSKY MARTINS open and closed cup apparatus.
4. Determination of Flash and Fire points of kerosene using PENSKY MARTINS open and closed cup apparatus.
5. Determination of Flash and Fire points of diesel using ABEL’s apparatus.
7. Determine the effect of kinematic viscosity of lubricant oil by using Red-wood Viscometer-I.
8. Determine the effect of kinematic viscosity of lubricant oil by using Red-wood Viscometer-II.
9. Determine the calorific value of coal by using “Bomb Calorimeter”.
10. Determination of apparent density of refractories.
11. Determine the calorific value of gaseous fuels by using “Junker’s Gas Calorimeter”.

Course Outcomes:

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

1. Gain hands-on experience on the equipment that facilitate property evaluation of fuels, and refractories.
2. Choose the fuels and refractories for specific use in construction and operation of different furnaces.
3. Select fuels, refractories to minimize overall cost of production for given applications.
4. Operate various types of fuel testing equipment and analyze the observations recorded.
ENGINEERING MATERIALS
(Open Elective - I)

III B.Tech. II-Semester

Pre-Requisites: Nil.
Course Objectives:
1. To gain knowledge about the uses and application of various ferrous metals and alloys.
2. To gain knowledge about the uses and application of various non ferrous alloys.
3. To gain knowledge about the uses and application of various ceramics, polymers and composites for different engineering applications.

UNIT-I
Ferrous Alloys: Introduction, Designations and classifications, Properties and applications of Carbon Steels: Low, medium and high carbon steels, Stainless steels and Cast Irons

UNIT-II
Nonferrous Alloys: Introduction, properties and applications of Aluminum Alloys, Magnesium Alloys, Copper Alloys and Titanium Alloys.

UNIT-III

UNIT-IV
Polymers: Introduction, Classification, Properties and Applications of Polymers, Polymerization, Degree of Polymerization, Typical Thermoplastics and Thermosets.

UNIT-V
Composites: Introduction, Classification, Properties and Applications of Polymer matrix, Metal Matrix Ceramic Matrix and Laminar composites.

Text Books:

Reference Books:
Course Outcomes:
At the end of the course, student will be able to
1. Appreciate the importance of ferrous alloys and their classification and apply the knowledge of heat treatment and analyze the effect of alloying elements.
2. Describe the properties of NFA and choose a particular alloy for a given application.
3. Correlate the structure, property and applications of ceramics and polymers.
4. Explain the importance of composites and select a particular composite for a given application.
5. Able to analyze the properties of different metallic and non metallic materials and justify their choice.
6. Able to take any technical assignment in R&D concerning engineering materials.
METALLURGY FOR NON METALLURGISTS
(Open Elective - I)

III B.Tech. II-Semester

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Pre-Requisites: Nil.

Course Objectives:
1. To describe the basic principles of metallurgy and the importance of metallurgy in various disciplines of engineering.
2. Gain thorough knowledge about heat treatment of steels.
3. Gain knowledge about properties and uses of cast irons and non ferrous metals.
4. Gain working knowledge of basic testing methods for metals.

UNIT-I
Introduction: Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels.

UNIT-II

UNIT-III
Cast irons: Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

UNIT-IV
Non Ferrous Metals: Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys.

UNIT-V

Text Books:

Reference Books:
1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
4. Metallurgy for Engineers- Clark and Varney.
Course Outcomes:

At the end of the course student will be able to:
1. Classify steels and understand the different crystal structures of metals and defects.
2. Establish heat treatment process – structure – properties correlation.
3. Know the metallurgical and mechanical properties of various cast iron and their applications.
4. Justify the choice of light metals and super alloys based on their properties.
5. Evaluate the various mechanical properties in materials by different methods.
6. Able to understand the areas and domains of metallurgy and materials.
NON-FERROUS EXTRACTIVE METALLURGY

III Year B.Tech. II-Sem L T P C
3 1 0 4

Pre-Requisites: Mineral Dressing and Principles of Extractive Metallurgy
Course Objectives:
1. To explain the various methods of extraction of non ferrous metals.
2. To draw the flow sheets for extraction of various non ferrous metals.
3. To describe the procedure and equipment used for production of non ferrous metals from their ores.

UNIT-I
Copper: Principal Ore and Minerals; Matte smelting – Blast furnace, Reverberatory; Electric furnace, Flash; Converting; Continuous production of blister Copper; Fire refining; Electrolytic refining, Hydro-Metallurgical copper extraction, Leaching processes, Recovery of copper from leach solutions, Electro-winning.

UNIT-II
Zinc: General Principles: Horizontal and vertical retort processes, Production in a Blast furnace, Leaching purification, Electrolysis, Refining.
Lead: Blast furnace smelting, Refining of lead bullion.

UNIT-III

UNIT-IV
Magnesium: Production of a hydrous Magnesium chloride from seawater and magnesite. Electro-winning practice and problem, refining, Pidgeon and Hansgrig processes.
Titanium: Upgrading of ilmenite, chlorination of titania, Kroll's process. Refining.

UNIT-V
Uranium: Acid and alkali processes for digestion of uranium ores, Purification of crude salt, Production of reactor grade UO₂ and uranium.
Simplified flow sheets for the extraction of nickel, tungsten and gold. Review of non-ferrous metal industries in India.

Text Books:
Reference Books:
1. Rare Metals Hand book - C.A. Hampel.

Course Outcomes:
At the end of the course, student would be able to recommend:
1. Get detailed information about the properties of non ferrous metals, ores of non ferrous metals, pre-treatment processes, thermodynamics and kinetics involved in extraction process.
2. Describe and explain ore treatment techniques and learn the fundamental concepts of metallurgical pre-treatment methods, production of metals from ore, concentrate and secondary sources.
3. Emphasize the strategic importance of raw and supplementary materials in the production, and explain the concepts of technological and economical feasibility.
4. Identify the beneficiation of by products materialize during the metal production, within the framework of technology-environment-ecology.
5. Explain processes based on an advanced thermodynamic perspective and explain material and energy flows related to extraction of metals and alloys.
6. Understand about Extractive metallurgy processes and explain their relative merits and demerits and also conduct a detailed and individual research about production of a specific metal, as part of their responsibility.
MATERIALS PROCESSING - II

III Year B.Tech. II-Sem

Pre-Requisites: Nil

Course Objectives:
1. To familiarize the students about stress and strain relationships under various conditions.
2. Explain the students about the background of fundamentals of metal working operations.
3. Analyze the behavior of metals during different plastic deformation processes.

UNIT-I


UNIT-II
Fundamentals of Metal Working: Classification of forming processes, mechanics of metal working for slab method and uniform deformation energy method. Cold working, recovery, recrystallization and grain growth, hot working, Strain-Rate effects, work of plastic deformation.

UNIT-III
Forging: Classification of forging processes, forging equipment. Forging in plane strain. Open-die forging, closed-die forging, forging of a cylinder in plane-strain, forging defects.


UNIT-IV
Rolling of Metals: Classification of rolling process, rolling mills, hot rolling, cold rolling, rolling of bars and shapes, forging and geometrical relationships in rolling. Simplified analysis of rolling load, rolling variables, problems and defects in rolled products. Theories of hot rolling, torque and horsepower, theories of cold rolling, torque and horsepower.

UNIT-V
Drawing of Rods, Wires and Tubes: rod and wire drawing, tube drawing processes, deep drawing and residual stresses in rod, wire and tubes.

Sheet metal forming: Processes and Equipment.
Text Books:
2. Mechanical working of metals - Avitzone.

Reference Books:
2. Mechanical behavior - Ed. Wulf.

Course Outcomes:
At the end of the course the student will be able to:
1. Use the Mohr’s circle to graphically analyze stresses and strains.
2. Compare, classify the different forming processes and analyze the behaviour of materials during forming processes.
3. Determine the forming processes controlling parameters.
4. Estimate required forming loads, powers of different forming equipment and processes.
5. Determine the cause of the defects that may take place during forming processes and precautions to be taken.
6. Integrate knowledge gained in this course to select and design a complete metal forming process for obtaining a desired product and solve numerical problems.
ENVIROMENTAL DEGRADATION OF MATERIALS

III Year B.Tech. II-Sem L T P C
4 0 0 4

Pre-Requisites: Engineering Chemistry, Thermodynamics and Kinetics and Principles of Extractive Metallurgy

Course Objectives:
1. Electrometallurgy principles in deposition winning and the efficiency of the bath to be discussed.
2. Testing methods are to be studied. Various ways in which corrosion takes place in metals/alloys together with corrosion protection methods and tests conducted are to be studied.
3. Able to use principles to understand, the prevention of corrosion.

UNIT-I
Electro chemical principles, thermodynamic aspects of electrochemical cells, Nernst equation, electrolysis, electrode potentials. Faradays laws, electroplating, electro winning.

UNIT-II
Electrochemical reactions, Polarization, passivity, environmental effects (oxygen, oxidizers, velocity, temperature, corrosive concentration, Galvanic coupling). Corrosion: Introduction, Definition and classification.

UNIT-III
Forms of corrosion, uniform corrosion, Two metal corrosion: Sacrificial anode, EMF and Galvanic Series, Environmental effects, Pitting corrosion, Crevice corrosion. Intergranular corrosion: Sensitization, weld decay, Knife-Line attack, Stress corrosion cracking: crack morphology, stress effects, environmental factors, metallurgical factors, Erosion corrosion: cavitation damage, fretting corrosion, Corrosion fatigue.

UNIT-IV

UNIT-V
Modern theory and applications of corrosion: Introduction, free energy, cell potentials, emf series, applications of thermodynamics to corrosion, Corrosion rate expressions and measurements, corrosion testing.

Text Books:
2. Electrometallurgy- Blum.
Reference Books:
1. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.

Course Outcomes:
1. Outline the electrochemistry of the corrosion process.
2. Identify and analyze the “Eight Forms of Corrosion”.
3. Describe the effects of specific corrosion environments prevailing in the oil and gas industry.
4. Select appropriate corrosion monitoring and control techniques.
5. To design for corrosion protection, minimization.
6. Review and select appropriate materials for corrosion resistant applications.
ADVANCED IRON AND STEEL MAKING  
(Professional Elective - II)  

III Year B.Tech. II-Sem  
L   T   P   C  
3   0   0   3  

Pre- requisites: Iron Making and Steel Making Technologies  

Course Objectives:  
1. To learn alternate routes of iron making based on coal and gas as a fuel and reductants.  
2. Impart knowledge about the important smelt reduction processes.  
3. Introduce the concepts of combined blow process, secondary steel making process and post solidification refining / remelting process.  

Unit I  
Introduction: Merits and demerits of blast furnace route of iron making.  

Unit II  
Smelting reduction: Introduction, Raw materials and fundamentals of smelting reduction. SR process classification of SR process (No of stages and type of furnace used) Salient features of important SR process: COREX process, FASTMEIT.  

Unit III  

Unit IV  
Construction details and processes taking place in Electric arc furnace Continuous casting of steel.  

Unit V  
Secondary SM – Introduction, Objectives of secondary steel making. Inert gas purging (IGP), RH process and DH process. ESR (Electro Slag Remelting) and VAR (Vacuum Arc Remelting).  

Text Books:  

Reference Books:  
Course out comes:
At the end of the course, student will be able to gain
1. Summarize the blast furnace operations, its merits and demerits
2. Appreciate the needs for alternate routes of iron making and classify different alternate routes of iron making after implementing thermodynamics and kinetic principles of DR technologies.
3. Predict the processes taking place in coal based and gas based routes of sponge iron making and the possible alternative processes to be followed suitable to the local conditions in view of energy, environmental and efficiency considerations.
4. Evaluate the operations taking place in basic oxygen steel making processes and processes using electric energy as a heat source.
5. Classify secondary steel making process, describe them, and can explain post solidification refining / remelting process.
COMPOSITE MATERIALS
(Professional Elective - II)

III Year B.Tech. II-Sem

Pre-Requisites: Nil

Course Objectives:
1. Describe the importance of composite materials and its constituents.
2. Familiarize the students with various types of fibers, their properties and processing techniques.
3. Introduce the various process techniques for composite materials.
4. To demonstrate the relationship among synthesis, processing and properties in composite materials.

UNIT-I
Introduction, Classification of Composite materials based on structure and matrix and reinforcements, Advantages and applications of composites, Functional requirements of reinforcement and matrix materials.

UNIT-II

UNIT-III

UNIT-IV
Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques. Interface in Metal Matrix Composites. Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites. Discontinuously reinforced Metal Matrix Composites: Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT -V

Text Books:
Reference Books:

Course Outcomes:
1. Can classify the composites, know the required properties, reinforcements and matrix materials and uses of composites.
2. Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure and the interfaces obtained.
3. Knowledge of processing techniques for polymer matrix, ceramic matrix and metal matrix composites and list out their properties and applications.
4. Ability to arrive at different deformation and failure mechanisms of composite materials under different loading conditions in engineering applications.
5. Able to explain the elastic constants and strengths of the composite.
6. Able to undertake any technical assignment in R&D and production of newer and smarter materials.
# ELECTRONIC MATERIALS

(Professional Elective - II)

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Pre- Requisites: Nil

Course Objectives:
1. To become familiar with the science, synthesis, evaluation, and applications of electronic materials.
2. To know the manufacturing processes associated with use of electronic materials for devices.

**UNIT-I**

**Electronic structure and its relevance in crystalline materials:** Review of quantum mechanics: Electron as waves and particles; Wave-function; Electron as a plane-wave, Operators; Schrodinger Equation, Wave-vector (k); Energy of free-electron as a function of wave-vector k (\( \varepsilon - k \) diagram, a parabola), k-space; Density-of states [\( g(\varepsilon) \)]; Fermi-sphere, -energy, -surface, -temperature, and – velocity. Electrons in a solid following Fermi-Dirac distribution; DC conductivity in metals. Lattice; Bravais-Lattice; Wigner-Seitz cell; k-space: Reciprocal space; Reciprocal lattice and it’s connection to its direct-lattice, Brillouin zone; Von-Lau condition of Bragg diffraction and boundaries of Brillouin-zone being the Bragg-Planes Electrons in a periodic-potential; Bloch Theorem, Kronig-Penny model; Origin of energy bands and band-gap; Free electron band diagram, Extended-, Periodic and reduced-zone representation for \( \varepsilon - k \) diagram; Allowed number of states in a band.

**UNIT-II**

**Electron Dynamics:** Group-velocity, electron dynamics from \( \varepsilon - k \) diagram and the concept of effective-mass and concept of holes; Conductivity in relation to band structure; Band structure of metals and semiconductors, and insulators; Band-overlap: why some metals show positive charge carriers in Hall-effect.

**UNIT-III**

**Semiconductors and Magnetic Materials:** Band diagrams, direct and indirect bandgap, applications of semiconductors; Effective-mass of electron in conduction-band and that of hole in valence-band Intrinsic semiconductors: Fermi-level; Density-of-states near the edges of conduction and valence-band; Fermi-dirac statistics approximated by Maxwell-Boltzman; Intrinsic charge-carrier concentration, Law-of mass-action; Direct vs Indirect Semiconductors, Extrinsic-semiconductor: Hydrogen-model for rough estimate of the donor and acceptor energy level, n- and p-type semiconductors; Population of impurity levels in thermal equilibrium, charge-carrier concentration in n- and p- type semiconductors; Fermi-level, Degenerate and non-degenerate semiconductors, determination of dopant levels and mobility measurements Semiconductor Devices: p-n junction and solar cells; Bandgap engineering: Solid-state LEDs, Lasers and IR detectors. Orbital and spin - permanent magnetic moment of atoms, diamagnetism, paramagnetism, and Pauli-paramagnetism, Ferro, anti-ferro and ferri magnetism, Fe, Co and Ni and alloy additions, ferrites, magnetic hysteresis, exchange energy, magnetocrystalline energy, magnetostriction; Highly correlated systems. Applications: Spintronics and memory devices Superconductors, Multiferroic materials
UNIT- IV
Ionic conductors and Dielectric materials: Ionic conduction – review of defect equilibrium and diffusion mechanisms; Theory of ionic conduction, conduction in glasses; Effect of stoichiometric and extrinsic defects on conduction, Applications in sensors and fuel cells.  Dielectric constants and polarization, linear dielectric materials, capacitors; Polarization mechanisms; Non-linear dielectrics, pyro-, piezo-, and ferro-electric properties, hysteresis and ferroelectric domains; Applications in sensors, actuators and memory devices.

UNIT -V

Text Books:

Reference Books:
5. Electronic Materials by Chelikowsky, James R., Franciosi, Alfonso (Eds.).

Course Outcomes:
After completing this course the student should be able to:
1. Indicate and explain important scientific parameters associated with electronic materials.
2. Describe different semiconductors and their properties with examples.
3. Explain the features and functioning of several electronic devices.
4. Describe the manufacturing processes associated with electronic materials and devices.
5. Use simple band diagrams to understand the optical activity of a semiconductor.
MATERIALS PROCESSING LAB – II

III Year B.Tech. II-Sem

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Pre Requisites: Materials Processing – II

Course Objectives:
This lab course is designed to
1. Know the behaviour of the materials under various types of loading.
2. Provide knowledge and experience in the measurement of various material properties.
3. To operate the various equipment like Erichson cupping, Rolling mill etc., and analyze the process in them.

List of Experiments:
1. Determination of formability limit diagram.
2. To study the kinetics of static re-crystallization in a cold worked metal.
3. To verify Hall-Petch relation in mild steel specimens.
4. Determination of the work hardening and strain rate sensitivity of a metal.
5. Determination of the effect of plastic anisotropy on the deformation behaviour.
6. Determine the effect of rolling variables on the mechanical properties of metals.
7. To study the forging operations in the production of a hook.
8. To conduct the ring compression test to determine the friction coefficient.
9. Determination of the flow pattern in plasticine clay when extruded through a die.
10. To study the defects produced in rolled products.
11. Determine the effect of cold work on hardness of the given material.
12. Determine the Modulus of Rupture or flexural modulus by bend test.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Determine strain hardening exponent, effect of grain size and plastic anisotropy under various types of experiments/ practical conditions.
2. Determine the effect of process variables affecting various forming methods.
3. Work on forging, extrusion and rolling mills and analyze and interpret the outcome of the processes.
4. Prepare formal laboratory reports.
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 organize 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 English Communication Skills (AECS) 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.

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 English Communication Skills (AECS) Laboratory shall have the following infrastructural 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
   - T. V, a digital stereo & Camcorder
   - Headphones of High quality

5. **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)**

6. **Books Recommended:**
ENVIRONMENTAL DEGRADATION OF MATERIALS LAB

III Year B.Tech. II-Sem

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Pre-Requisites: Environmental Degradation of Materials

Course Objectives:
1. This lab course is designed to conduct the experiments on electro deposition, verification of Faraday’s laws and evaluation of factors affecting on corrosion.
2. To provide understanding of basic electro kinetics.
3. To provide basic knowledge on current efficiency for various electrolytes and electro metallurgy processes.

List of Experiments:
1. Electroplating of copper on brass and to study the influence of current density on current efficiency.
2. Electroplating of Nickel using watt’s bath and to study the influence of current density on current efficiency.
3. To anodise the given aluminium sample and to colour with a dye and to measure the thickness of the oxide film.
4. To determine the throwing power of electroplating bath.
5. Electroplating of chromium on mild steel and to study the influence of current density on current efficiency.
6. To understand the principles in galvanic cell corrosion.
7. To study the pitting corrosion of aluminium, stainless steel in suitable environments.
8. To conduct uniform corrosion.
9. Electro winning of copper by using aqueous electrolyte.
10. Electro winning of copper from ores.

Course Outcomes:
Through this laboratory practice, the student will be able:
1. To judge the process variables like current efficiency, current density.
2. To obtain desired electro deposition.
3. Hands on experience on equipment designed for evaluation of corrosion studies.
INDIAN CONSTITUTION

III Year B.Tech. II-Sem

Pre-Requisites: Nil

Course Objectives: Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

UNIT – I:
History of Making of the Indian Constitution:
- History
- Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution:
- Preamble
- Salient Features

UNIT – II:
Contours of Constitutional Rights & Duties:
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties

UNIT – III:
Organs of Governance:
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
Executive:
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT – IV:
Local Administration:
- District’s Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT – V:
Election Commission:
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:
1. The Constitution of India, 1950 (Bare Act), Government Publication.

Course Outcomes:
Students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956
INTRODUCTION TO INSTRUMENTATION

IV Year B.Tech. I-Sem

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Pre- Requisites: Nil
Course Objectives:
To have a knowledge of:
1. Electronic Instruments.
2. Pressure measurements.
3. Flow measurements.
4. Vibration, Viscosity and Humidity Level measurement.
5. Various analyzers.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT- V

Text Books:
Reference Books:

Course Outcomes:
1. 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.
2. Comprehend various pressure measurements.
3. Make accuracy statements for various types of measurements.
4. Differentiate between digital and analogue measurements and demonstrate advantages/disadvantages of each.
5. To be able to describe the operation of instruments used for various gas, liquid and solid materials.
MATERIALS CHARACTERIZATION TECHNIQUES

IV Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. To explain and describe the various working techniques of optical microscope, Scanning and Transmission Microscopes used for evaluating material properties.
2. To explain and describe the various working techniques of XRD, SPM, AFM for evaluating material properties.
3. To differentiate and compare between various characterization techniques.
4. Obtain knowledge on the various thermal analyses techniques.

UNIT – I
Optical Microscopy–Introduction, optical principles, Instrumentation, specimen preparation- metallographic principles, Imaging Modes, Applications, Limitations.

UNIT – II
(a) Scanning Electron Microscopy (SEM) - Introduction, instrumentation, Contrast formation, Operational variables, Specimen Preparation, Imaging Modes, Applications, and Limitations.
(b) Transmission Electron Microscopy (TEM) - Introduction, instrumentation, Specimen preparation –pre thinning, final thinning, Image modes-mass density contrast, diffraction contrast, Phase contrast, Applications, Limitations.

UNIT – III
X-Ray Diffraction (XRD) - Introduction, Basic principles of diffraction, X-ray generation, Instrumentation, Types of analysis, Data collection for analysis, Applications, Limitations.

UNIT – IV
Thermal Analysis: Introduction, Basic thermodynamics and heat transfer, common characteristics-Instrumentation, experimental parameters, Different types used for analysis, Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic Mechanical analysis- Basic Principles, Instrumentation, working principles, Applications, Limitations.

UNIT – V

Text Books:
Reference Books:

Course Outcomes:
At the end of the course, student will be:
1. Able to use metallurgical microscopes to analyze the experimental results.
2. Understand the various specimen preparation techniques for SEM, TEM and analyze the experimental results.
3. Describe the construction of XRD machine and understand its principle and analyze / interpret the experimental results.
4. Conduct characterization measurement by thermal analysis and solve problem using the thermo dynamic principles.
5. Knowledge on thermal analyses methods such as DSC, calorimetry and dilatometry etc.,
6. Analyze, evaluate and interpret data and solve practical characterization problems using modern tools like SPM, AFM etc.
CORROSION PROCESS AND CONTROL
(Open Elective – II)

IV B.Tech. I-Semester

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Pre-Requisites: Nil

Course Objectives:
1. To list out various atmospheres responsible for corrosion and understand the various corrosion combating techniques.
2. To determine corrosion rate/resistance of metals and alloys.
3. To demonstrate electrometallurgy principles in deposition winning and the efficiency of the bath.
4. To explain corrosion protection methods and tests.

UNIT-I
Introduction, Electro Chemistry principles, Corrosion, Introduction and Definition, electrochemical reactions, Polarization, passivity, environmental effects (oxygen, oxidizers, velocity, temperature, corrosive concentration, Galvanic coupling).

UNIT-II
Forms of corrosion, uniform corrosion, Two metal corrosion: Sacrificial anode, EMF and Galvanic Series, Environmental effects, Pitting corrosion: Pit shape and growth, Autocatalytic Nature of pitting, Crevice corrosion.

UNIT-III
Intergranular corrosion: Sensitization, weld decay, Knife-Line attack, Stress corrosion cracking: crack morphology, stress effects, environmental factors, metallurgical factors, Erosion corrosion: cavitation damage, fretting corrosion, Corrosion fatigue.

UNIT-IV

UNIT-V
Modern theory and applications of corrosion: Introduction, free energy, cell potentials, emf series, applications of thermodynamics to corrosion, Corrosion rate expressions and measurements, corrosion testing.

Text Books:
Reference Books:

Course Outcomes:
At the end of the course the student will be:
1. Able to interpret electro chemical phenomenon.
2. Can explain different types of corrosion, their causes, effect and able to identify the different remedial measures to be taken.
3. Able to design corrosion resistant structures and materials.
4. Determine the thermodynamic causes of corrosion.
5. Conduct corrosion tests and able to quantify the corrosion processes.
6. Able to graphically represent and interpret Eh-pH, pourbix extrapolation techniques.
TESTING OF MATERIALS
(Open Elective- II)

IV B.Tech. I-Semester

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Pre-requisites: Nil

Course Objectives:
1. To gain an understanding of the response of various metals under the application of stress and/or temperature.
2. Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN
3. Obtain a working knowledge of creep and fatigue testing methods and analysis of data.
4. To get an exposure to NDT techniques for detection of various types of flaws.

UNIT–I
Introduction, Importance of testing.
Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell hardness tests.
The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve.

UNIT–II

UNIT–III

UNIT–IV

UNIT–V
NDT: Principle, operation, advantages and limitations of Liquid Penetrant, Magnetic Particle, Radiography and Ultrasonic tests.

Text Books:
2. Mechanical behavior - Ed. Wulf.

Reference Books:
Course Outcomes:
At the end of the course the student will be able to:
1. Understand and interpret the results of various hardness tests and impact tests.
2. Evaluate various tensile properties of ferrous and non-ferrous metals and solve problems related to the tensile tests.
3. Analyze the modes of failure occurring due to fatigue and suggest remedial measures.
4. Analyze the methods of failure of materials at high temperature by creep and stress rupture and the mechanisms responsible for fracture.
5. Determine appropriate tests to be employed to determine the given mechanical properties using both destructive and non-destructive techniques.
6. Knowledge of various testing methods based on destructive & non-destructive techniques and their importance in enhancing service life of the component.
LIGHT METALS & ALLOYS
(Professional Elective – III)

IV Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
This course is mainly intended:
1. To give an exposure of various alloy systems, phase diagrams and their applications.
2. To highlight the importance of alloy selection.
3. To demonstrate the influence of composition, processing and microstructural effect on properties of the non-ferrous alloys.

UNIT-I
Aluminium alloys: Classification, Properties and applications, Physical metallurgy of Al-Cu alloys, Al-Mg alloys, Al-Zn alloys, Al-Mn alloys, Al-Si alloys, and Al-Li alloys, Ternary phase diagrams: Al-Cu-Mg alloys, Al-Si-Mg alloys and Al-Zn-Mg alloys.

UNIT-II
Magnesium Alloys: Classification, properties and applications, Alloying elements to magnesium and their purpose, Designation of magnesium alloys, Temper designation of magnesium alloys, Precipitation hardening in Magnesium alloys, Mg-Al-Zn alloys, Corrosion resistance of Mg-alloys.

UNIT-III
Titanium alloys: Classification, properties and applications, Interstitial solid solutions of titanium, Strengthening mechanisms of Titanium alloys. Titanium alloys for aerospace and aero engine applications.

UNIT-IV

UNIT-V
Beryllium alloys: Classification properties and applications, Processing of Beryllium alloys, Al-Be alloys, Corrosion resistance of Beryllium alloys.

Text Books:
Reference Books:
1. Heat treatment, structure and properties of Non ferrous alloys - Charlie Brooks, ASM Metals Park, Ohio, USA.

Course Outcomes:
At the end of the course, the student will be:
1. Able to classify Aluminum alloys and understand the importance of structure - property correlation in binary and ternary alloys.
2. Knowledge of Magnesium and Zinc alloys and their applications.
3. List out the properties of Titanium and its alloys and comprehend their usage.
4. Analyze the importance of properties and applications of Beryllium alloys.
5. Can develop and design stronger and safer new light weight alloys with the knowledge of metal properties for specialized applications with minimum consumption of materials.
FATIGUE AND FRACTURE MECHANICS
(Professional Elective – III)

Pre-Requisites: Nil

Course Objectives:
1. To study the different types of fatigue failures and their mechanisms in the engineering applications.
2. To study the basic theory of fracture mechanics and its relationship with fatigue and creep failure mechanisms.
3. To understand the damage tolerance approach in the life estimation of structures.

UNIT-I
Introduction and historical overview, S - N curves, Types of fatigue – low cycle fatigue, high cycle fatigue, very high cycle (giga cycle) fatigue, Fatigue test methods and equipment, Total life approaches based on cyclic stress and cyclic strain, Cyclic hardening and softening in single crystals and polycrystals.

UNIT-II

UNIT-III
Local strain approach, effect of different factors on fatigue – Stress concentration, Size, Surface, Temperature, Frequency, Environment, Microstructure, Residual stresses, Fretting, Creep-fatigue interaction, Multiaxial stresses, Thermomechanical loading, Variable amplitude loading, Load sequence, Crack closure, Effect of notches.

UNIT-IV
Fatigue behaviour of different materials – Metallic materials and weldments, Ceramics, Polymers, Composites, Metallic glasses, Shape memory alloys, Ultrafine grained materials, Nanocrystalline materials, Biomaterials, Metallic foams.

UNIT-V
Case studies on fatigue failures, Design considerations, Methods for fatigue life improvement.

Text Books:
Reference Books:

Course Outcomes:
After completing this course, the student will have:
1. Complete understanding of flow stress and S-N curve.
2. The ability to identify the characteristic fatigue failures in the engineering structures.
5. Knowledge on the methods of combating and preventing further failure.
6. Able to comprehend the failure theories using case studies.
FAILURE ANALYSIS
(Professional Elective– III)

IV Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. To highlight factors governing the failure of materials and types of failures.
2. To evaluate the mechanisms and environmental effects associated with failure.
3. To identify various failures in heat treatment and deformation processing, and methods to prevent them.

UNIT-I
Aims of failure analysis, general procedures of failure analysis. Important factors causing the premature failure of metallic components and structures, classification of failure sources: Design deficiencies, material deficiencies, processing deficiencies, assembly errors, service conditions, neglect and improper operation. Methods and equipment for failure analysis, Sample selection and treatment, equipment for materials examination, materials analysis equipment for failure analysis, commonly used NDT methods.

UNIT-II
Fractography. Types of failures: ductile, brittle, fatigue, creep, corrosion, wear.
Fatigue failures, fractography, effect of variables: part shape, type of loading, stress concentration, metallurgical factors, etc. Wear failures, adhesive, abrasive, erosive, corrosive wear.
Corrosion failures, types of corrosion: uniform, pitting, selective leaching, intergranular, crevice, etc.
Elevated temperature failures, creep, thermal fatigue, microstructural instability, oxidation.

UNIT-III
Failure mechanisms. Embrittlement phenomena. Environmental effects.

UNIT-IV
Failures due to faulty heat treatments. Failures in metal forming and welding.

UNIT-V
Case studies in failure analysis and prevention of failures.

Test Books:
Reference Books:

Course Outcomes:
After completing this course the student will have:
1. The ability to identify the types of failures in engineering components under service.
2. Able to determine fracture toughness of ductile and brittle materials.
3. Knowledge of the tools and techniques to perform failure analysis.
4. Ability to perform fractographic analysis after various failures.
5. The ability to identify different failure mechanisms resulting from manufacturing processes.
6. Able to analyze the failures with the help of case studies and suggest prevention methods for failure.
SURFACE ENGINEERING
(Professional Elective -IV)

IV Year B.Tech. I-Sem

Pre-Requisites: Physical Metallurgy and Thermodynamics and Kinetics

Course Objectives:
1. To provide a state-of-the-art knowledge to the students about the various surface engineering techniques.
2. To explain the importance, need of surface engineering and past, present and future status of surface engineering.
3. To comprehend the laser processing, electrons and ion beam processing of surfaces, to characterize and evaluate coatings etc.
4. To understand the combat techniques to protect the surfaces from wear, corrosion and other failure causing environments.

UNIT-I
Introduction to surface modification, need for surface modification, surface properties, surface property modification, history of surface modification techniques.

UNIT-II
Plating and coating process: concept of coating, types of coatings, properties of coatings, hard facing, anodizing, PVD, CVD, Electro deposition, Electro less deposition, hot deposition, hot dipping.

UNIT-III

UNIT-IV

UNIT-V
General design principles related to surface engineering, design guidelines for surface preparation, surface engineering solution to specific problems. Case studies related to Engineering Components, Shafts, Bearings, Turbine blades.

Text Books:
Reference Books:

Course Outcomes:
At the end of the course, the student will be able to:
1. Gain knowledge of different surface properties, appreciate the need for surface modification and past practices.
2. Knowledge of plating and coatings techniques.
3. Knowledge of surface modification by chemical and thermal processes.
4. Differentiate between the methods used and indicate their relative merits and demerits.
5. This course provides an opportunity to the students to understand the various aspects associated with industrial applications of surface engineering.
6. Design various surface modifications according to the needs, compatibility and efficiency of the processes and the desired output.
ENERGY MATERIALS  
(Professional Elective – IV)  

IV Year B.Tech. I-Sem  

Pre-Requisites: Nil 

Course Objectives: 
1. To understand energy requirements on domestic and international scale. 
2. To learn the operating principle of several environmentally friendly energy technologies. 
3. To identify the material issues relevant to these technologies and to evaluate various operational aspects associated with these technologies. 

UNIT-I 
Energy requirements in a global scale and in the Indian context. Global context in terms of reducing greenhouse-gas emissions that contribute to climate change. Develop the infrastructure to meet the needs of other energy-consuming sectors, the scale of India's energy resources and its energy production. Examples of coal-based DRI, pulp and paper making and small-scale cement kilns. 

UNIT-II 
Evaluation of energy sources from the perspective of clean energy. Carbon equivalent, The carbon footprint of various forms of energy. Renewable energy and carbon Credits. Life cycle assessment, Re-cycling. 

UNIT-III 
Introduction to different types of energy storage and conversion devices and technologies. Synthesis and characterization of materials used for these technologies, Properties desired in the materials, Techniques to evaluate the properties and performance, failure modes and analysis and environmental impact. 

UNIT-IV 
Technologies and function of Energy Storage devices, Batteries & Super Capacitors. 

UNIT-V 
Solar energy conversion devices, Wind & Mechanical Energy storages. 

Text Books: 
2. Energy Materials by Duncan W. Bruce, Dermot O'Hare, Richard I. Walton. 

Reference Books: 
Course Outcomes:
After completing this course the student should be able to:
1. Evaluate an energy technology for environmental friendliness.
2. Explain the operating principle of several energy technologies.
3. Indicate the material requirements for these energy technologies.
4. Demonstrate the ability to understand the characterization, performance, and failure data related to these technologies.
5. Comprehend various energy storage, conversation devices and technologies.
6. Demonstrate the various renewable energy sources and characterize the materials which can be used.
NON DESTRUCTIVE TESTING
(Professional Elective – IV)

IV Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. Provide an opportunity to learn visual methods, electrical methods and magnetic methods.
2. To develop a fundamental understanding of ultrasonic testing of material and radiographic methods.

UNIT-I
Introduction; Visual Methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

UNIT-II
Penetrant Flaw Detection: Principles, Process, and Penetrant systems; Liquid penetrant materials; emulsifiers; cleaners, developers, sensitivity; Advantages, Limitations, applications.
Magnetic Methods: Methods of generating fields; magnetic particles and suspending liquids Magnetography, field sensitive probes; applications. Measurement of metal properties, Advantages, Limitations.

UNIT-III
Electrical Methods: Eddy current methods; potential-drop methods, applications.
Electromagnetic Testing: Magnetism; Magnetic domains; Magnetization curves; Magnetic Hysteresis; Hysteresis-loop tests; comparator - bridge tests Absolute single-coil system; applications.

UNIT-IV
Ultrasonic Testing of Materials: Generation of Ultrasonic waves, general characteristics of ultrasonic waves; methods and instruments for ultrasonic materials testing; special techniques, Advantages, Disadvantages, Applications.
Acoustic emission methods: Basic Principles, methods and applications.

UNIT-V
Radiographic Methods: Limitations; Principles of radiography; sources of radiation, Ionizing radiation - X-rays sources, gamma-rays sources Recording of radiation; Radiographic sensitivity; Fluoroscopic methods; special techniques; Radiation safety.

Text Books:
1. Non-Destructive Testing by P. Halmshaw.
Reference Books:

Course Outcomes:
The end of the student gain will be:
1. Complete knowledge on microscopic evaluation and dynamic inspection.
2. Knowledge about application of NDT methods like visual observation, penetrant detection, electrical methods etc.
3. Ability to use ultrasonic testing and radiographic methods for checking various types of defects.
4. Selection of suitable NDT methods for various environments.
5. Documentation of testing and evaluation of results for further analysis.
Pre- Requisites: Nil
Course Objectives:
1. The prime objective of this course is to make students become effective communicators and enhance their presentational and creative abilities.
2. Enhance the technical knowledge of the selected topics.

Course Outcomes:
1. Students will be able to show competence in identifying relevant information, defining and explaining the topics under discussion.
2. Able to evaluate information and use and apply relevant theories concerned to the chosen topic.
3. Able to use conventional and modern methods of presentation techniques to support the presentation / topic.
4. Develop presentation skills and confidently face the audience.
5. Respond to a range of questions posed and take part in the discussions fruitfully.
6. Recognize and demonstrate effective oral and written formats.
MINI PROJECT

IV Year B.Tech. I-Sem

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Pre-Requisites: Nil

Course Objectives:
1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:
At the end of the course the student will be able to:
1. Exposed to the various practical aspects relating to Metallurgical Engineering with respect to characterization, analysis and extraction principles and are getting hands on experience in using / handling equipments and hence they are able to solve problems and analyze the results.
2. Carry out project work related to modern and novel techniques and synthesis of newer materials with wide applications and tailor made properties.
3. Exposed to various safety measures, ethical practices and environmental concerns.
4. Good attitude, co-ordination and co-operation is developed when interacting with various categories of persons like scientists, production engineers, quality control engineers and team members etc.
5. Conduct the project in groups or as an individual and exhibit work, project, and financial management.
6. Deliver a well-organized technical presentation at conferences and other symposia and write a project report.
MAJOR PROJECT (PHASE-I)

IV Year B.Tech. I-Sem

Pre-Requisites: Nil

Course Objectives:
1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:
At the end of the course the student will be able to:
1. Identify a research problem after thorough literature review in metallurgical engineering, plan and execute experimental work to obtain desired results.
2. Appreciate the need to work in teams and to take a lead in execution of the project allotted.
ALLOY STEELS
(Open Elective - III)

IV B.Tech. II-Sem

Pre-Requisites: Nil
Course Objectives:
This course deals with:
1. Describe the physical metallurgy of steels and alloy steels.
2. Explain the microstructure and properties of steels and alloy steels.
3. Make judgments on microstructural evolution and properties developed in alloy steels.

UNIT – I

UNIT – II
Medium- High carbon ferrite-pearlite steels – structure property relationships, Bainitic steels, Low-carbon bainitic steels requirements, development and choice of alloying elements, Mechanical properties, microstructure and impact properties, High-Carbon bainitic steels.

UNIT – III
Ultra-high strength steels: Classification and applications. Description steels tempered at low temperatures, secondary hardening, thermo-mechanical treatments, rapid austenitizing treatments, structure-property relationships in tempered martensite, cold-drawn pearlite steels, maraging steels.

UNIT – IV
Stainless steels: Classification, Composition, role of alloying elements, Heat treatment, microstructure and applications.

UNIT- V
Tool steels and Heat resistant steels: Classification, Composition, role of alloying elements, Heat treatment, microstructure and applications.

Text Books:

Reference Books:
Course Outcomes:
1. Able to classify plain carbon steels, alloy steels and differentiate the steels and appreciate the role of alloy elements in steels and how to modify the structures to get the desired properties in steels.
2. Know the importance of structure - property correlation study in HSLA, Ultra high strength steels etc., and their suitable applications.
3. Analyze the importance of composition, heat treatment and microstructure effects on properties and uses of stainless steels.
4. Analyze the importance of composition, heat treatment and microstructure effects on properties and uses of tool steels and heat resistant steels.
5. Able to apply the knowledge gained on microstructural evolution and its stability to optimize the processing routes for specific applications.
HIGH TEMPERATURE MATERIALS  
(Open Elective – III)

IV B.Tech. II-Sem

Pre-Requisites: Nil

Course objectives:
1. To learn and design material’s microstructure for high temperature applications.
2. To learn scientific issues related to high temperature such as creep, oxidation and material degradation.
3. To study the properties which improve high temperature resistance.

UNIT-I

UNIT-II
Fatigue, thermal fatigue, ageing, structural changes, material damage, crack propagation, damage mechanics, life time analysis, Creep-Fatigue interaction.

UNIT-III

UNIT-IV
Super alloys: their processing, high temperature mechanical properties, Corrosion behaviour, Ceramics for applications in refractory technology, Properties and applications of high temperature polymers.

UNIT-V
Refractory metals and alloys, Intermetallics, Carbon-Carbon composites, Ceramic matrix composites for refractory applications, Industrial, defence and nuclear applications.

Text Books:

Reference Books:
1. Introduction to the High Temperature Oxidation of Metals by Neil Birks, Gerald H. Meier, and Frederick S. Pettit (Paperback - Jul 23, 2009)
Course Outcomes:

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

1. Outline the different processes responsible for failure of materials at high temperature.
2. Able to relate the causes for creep failure and choice of creep resistant materials.
3. Able to interpret the structural changes taking place during fatigue and aging and carry out analysis of data.
4. Able to interpret the chemical causes for failure at high temperature.
5. Distinguish the role of ceramics, polymers, super alloys etc., at high temperature.
6. Analysis of data available for design and improve the existing materials.
SOLIDIFICATION PROCESSING  
(Professional Elective - V)  

IV Year B.Tech. II-Sem  

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Pre-Requisites: Physical Metallurgy and Material Processing - I  

Course Objectives:  
1. To inculcate the metallurgical aspects during solidification of metal and alloys.  
2. To impart knowledge about solidification of casting with detail emphasis on calculation of gating/riser system.  
3. To impart knowledge about solidification behaviour during welding and effect of microstructure in HAZ.  

UNIT-I  
Principles of solidification: Nucleation and growth of pure metals and alloys, Cooling curves, heat transfer associated in nucleation and growth, eutectic solidification; Homogeneous and Heterogeneous nucleation.  

UNIT-II  
Solidification of ingots and castings: formation of plane front columnar, equiaxed and dendritic structures, Effect of composition, moulding materials and cooling rate on solidification pattern.  

UNIT-III  
Segregation and shrinkage phenomena in castings, calculation of solidification time for casting, heat transfer calculations in metal casting, principles of chill design.  

UNIT-IV  
Heat transfer in weldments, dissipation of welding heat, cooling rates, weld metal cooling curves, peak temperature, calculating width of heat affected zones, solidification rate and affects of heat input.  

UNIT-V  
Heat conduction using without phase change and with phase change by finite element method, finite volume method and finite differences methods.  

Text Books:  

Reference Books:  
4. G.J.Davies – Solidification and casting, Applied science publishers, 1973  
5. Solidification Processing; Fleming, M.C., McGraw-Hill, N.Y., 1974  
6. Solidification of Casting; Ruddle, R.W., Institute of Metals, 1957
Course Outcomes:
The student will be able to:
1. Explain the principles and practice of directional solidification.
2. Describe the procedures used for controlling porosity and shrinkage during solidification processing.
3. List out the microstructural differences between cast and wrought metallic alloy products.
4. Knowledge about the microstructural mechanisms associated with metals joining operations including heat affected zones.
NON METALLIC MATERIALS
(Professional Elective - V)

IV Year B.Tech. II-Sem

Pre-Requisites: Nil

Course Objectives:
1. To introduce the student to the range of non-metallic materials available for engineering.
2. To understand the classification and significance of nonmetallic materials to apply them in Industries.
3. To get an exposure to the techniques associated with the synthesis, processing and characterization of these materials.
4. To become aware of the applications where these materials are preferred.

UNIT-I

UNIT-II

UNIT-III
Polymers: Structure, properties and applications of thermoplastics and thermosets. Conducting and biopolymers.

UNIT-IV
Composites: Introduction, classification, and applications of composite materials. Manufacturing of Polymer matrix, metal matrix, and ceramic matrix composites.

UNIT-V

Text Books:
2. Introduction to Ceramics; Kingery, Bowen, Uhlman. Wiley India Pvt Limited, 2012.

Reference Books:
Course Outcomes:
After completing this course the student can:
1. List the prominent non-metallic materials available for engineering applications.
2. Indicate the synthesis and processing steps associated with non-metallic materials.
3. Indicate the structure property relations in non-metallic materials.
4. Understand the behavior of each non-metallic material in detail.
5. Indicate the uses for which non-metallic materials are preferred.
6. Explain the manufacturing methods of industrially important adhesives and foams.
FUNCTIONAL MATERIALS
(Professional Elective – V)

IV Year B.Tech. II-Semester

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Pre-Requisites: Nil

Course Objectives:
1. To introduce the student to functional materials and the science behind the performance of the functional materials.
2. To enable the student to understand the applications of functional materials.
3. To study about semi conductors, dielectrics, Piezo, Ferro electric and smart materials.

UNIT-I

UNIT-II

UNIT-III
Basics of semiconductor electrical properties, operation of the semiconductor devices. Eg: Band structure, Diode, MOS device capacitor, MOS transistor structure and operation, Transistor formation and Transistor isolation.

UNIT-IV
Dielectrics, Piezo and ferroelectric materials: Introduction, properties, applications. Recent developments in advanced dielectric, piezoelectric and ferroelectric materials. High strain high performance piezo- and ferroelectric single crystals; Electric field-induced effects and domain engineering; Morphotropic phase boundary related phenomena; High power piezoelectric and microwave dielectric materials; Nanoscale piezo- and ferroelectrics.

UNIT-V
Smart materials: Introduction, definition, applications, factors affecting properties of smart materials. Applications in electronic, communication, aerospace, automotive, energy industries.

Text Books:
Reference Books:
2. Advanced Functional Materials by Woo, Hee - Gweon, Li, Hong.

Course Outcomes:
After completion of the course the student will be able to:
1. Indicate the various types of functional materials.
2. Explain the principle of operation of the functional materials.
3. Indicate the applications of the functional materials.
4. Judge the factors that affect the interface and size on the properties of functional materials.
5. Identify the applications of functional materials in advance and modern systems.
POWDER METALLURGY  
(Professional Elective - VI)

IV Year B.Tech. II-Sem  
L  T  P  C  
3  0  0  3

Pre-Requisites: Nil

Course Objectives:
1. To build the necessary background of emergence and importance of powder metallurgy scope and limitations.
2. Obtain a necessary knowledge about various powder production techniques and characteristics.
3. Obtain a working knowledge of compaction and sintering techniques.
4. Gain an effective knowledge of applications of powder metallurgy products.

UNIT–I
Introduction: Emergence and importance of powder metallurgy: Comparison of powder metallurgy with other fabrication techniques, its scope and limitations.

UNIT–II
Production and Characterization of powders: Different methods of production of metal powders: General characteristics of metal powders, particle shape, flow rate, apparent density, and specific surface area, particle size distribution, influence of manufacturing process on powder characteristics.

UNIT–III

UNIT–IV

UNIT –V
Magnetic materials: Soft magnetic materials (Fe, Fe-Ni); Permanent magnets (Alnico, SmCo₅), Cemented carbides; Cermets.

Text Books:
Reference Books:
1. Introduction to Powder Metallurgy – J.S. Hirshhorn.

Course Outcomes:
At the end of the course the student will be able to:
1. Appreciate the importance of powder metallurgy technology for production of materials and components in comparison with other fabrication techniques.
2. List out the advantages, limitations and applications of powder metallurgy technique.
3. Able to choose the production method to get the required size and shape of the powders.
4. Knowledge of various characterization methods to control the properties of the powders.
5. Describe the consolidation and sintering processes in powder metallurgy route.
6. Can develop and design powder metallurgical components for specific applications and needs of various industries.
BIO MATERIALS  
(Professional Elective - VI)

IV Year B.Tech. II-Sem

Pre- Requisites: Nil

Course Objectives:
1. To introduce the student to the range of biomaterials and the science and engineering of biomaterials.
2. To understand constraints associated with the use of biomaterials.
3. To study various real time applications of bio materials.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
External field and cell – material interaction, Tissue Engineering and Wound healing. Design concept of developing new materials for bio-implant applications.

Text Books:
1. Introduction to Biomaterials: Basic Theory with Engineering Applications by C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford and Gopinath Mani
Reference Books:

Course Outcomes:
After completing the course, the student will be able to:
1. Explain the types of biomaterials and their relative advantages and disadvantages.
2. Indicate the constraints placed on the use of materials in biological environments.
3. Explain the characterization of materials from the perspective of application as a biomaterial.
4. Explain the factors affecting the bio compatibility of materials.
5. Develop and design new advanced materials.
6. Develop biodegradable materials for sensitive applications.
TRANSPORT PHENOMENA  
(Professional Elective - VI)

IV Year B.Tech. II-Sem                                           L   T   P   C  
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Pre-Requisites: Nil

Course Objectives:
1. This course will introduce the concepts of fluid flow, heat transfer and mass transfer with behavior and processing of engineering materials as the focus.
2. To learn Newton’s law of viscosity, Navier-stokes equation, Darcy’s law and their applications.
3. To study the methods of diffusion and their applications.

UNIT-I
Balance of quantities using elemental volume approach, continuity equation Newton's law of viscosity.

UNIT-II
Navier-Stokes equation, laminar flow problems, exact solutions in rectangular, cylindrical and spherical coordinate systems.

UNIT-III
Friction factors, correlations for turbulent regime, Darcy's law, flow through porous media, Fundamentals of heat conduction, convection, radiation and their combined effect.

UNIT-IV
Steady and unsteady heat transfer, exact analytical solutions, correlations for conjugate heat transfer. Coupled phenomena in transport, Non-dimensional numbers and their correlations of different regimes and analogies.

UNIT-V
Diffusion and its application in solid state, convective mass transfer, unsteady diffusion in finite and infinite bodies, diffusion and chemical reactions.

Text Books:

Reference Books:
1. Transport phenomena in materials processing : D.R. Poirier and G.H. Geiger, TMS.
Course Outcomes:
At the end of this course, the student should be able to:
1. Demonstrate and understanding of heat transfer, fluid flow and mass transfer.
2. Pose a problem in transport phenomena as a balance equation.
3. Make suitable assumptions to make the problem a well defined one.
4. Identify suitable geometry and boundary conditions for the problem.
5. Solve simple partial differential equations relevant to transport phenomena.
6. Plot different parameters and interpret the solutions.
MAJOR PROJECT (PHASE-II)

IV Year B.Tech. II-Sem

Pre- Requisites: Nil

Course Objectives:
1. This course is mainly intended to make the students acquire real time practical experience on the industry oriented processes, technologies, and applications.
2. Students will be exposed to sophisticated equipments and modern technologies.

Course Outcomes:
At the end of the course the student will be able to:
1. Exposed to the various practical aspects relating to Metallurgical Engineering with respect to characterization, analysis and extraction principles and are getting hands on experience in using / handling equipments and hence they are able to solve problems and analyze the results.
2. Carry out project work related to modern and novel techniques and synthesis of newer materials with wide applications and tailor made properties.
3. Exposed to various safety measures, ethical practices and environmental concerns.
4. Good attitude, co-ordination and co-operation is developed when interacting with various categories of persons like scientists, production engineers, quality control engineers and team members etc.
5. Conduct the project in groups or as an individual and exhibit work, project, and financial management.
6. Deliver a well-organized technical presentation at conferences and other symposia and write a project report.