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)

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

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

Program Specific Outcomes (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 ENGINEEERING)
COURSE STRUCTURE

I YEAR **I SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1	BSC	Mathematics-I	3	1	0	4
2	BSC	Engineering Physics	3	1	0	4
3	ESC	Programming for Problem Solving	3	0	0	3
4	ESC	Engineering Graphics	1	0	4	3
5	BSC	Engineering Physics Lab	0	0	3	1.5
6	ESC	Programming for Problem Solving Lab	0	0	3	1.5
		Total Credits	**10**	**2**	**10**	**17**

I YEAR **II SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1	BSC	Mathematics-II	3	1	0	4
2	BSC	Engineering Chemistry	3	1	0	4
3	ESC	Engineering Mechanics	3	1	0	4
4	HSMC	English	2	0	0	2
5	BSC	Engineering Chemistry Lab	0	0	3	1.5
6	ESC	Engineering Workshop	1	0	3	2.5
7	*HSMC	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19**

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
B.TECH. FOUR YEAR DEGREE COURSE
(METALLURGICAL ENGINEEERING)
COURSE STRUCTURE

II YEAR **I SEMESTER**

S. No	Course Code	Course Title	L	T	P	Credits
1	BSC	Engineering Mathematics-III	3	1	0	4
2	PCC-MM	Mineral Dressing	3	0	0	3
3	PCC-MM	Physical Metallurgy	3	1	0	4
4	PCC-MM	Thermodynamics and Kinetics	3	1	0	4
5	PCC-MM	Metallurgical Analysis	3	0	0	3
6	PCC-MM	Mineral Dressing Lab	0	0	2	1
7	PCC-MM	Metallography Lab	0	0	2	1
8	PCC-MM	Metallurgical Analysis Lab	0	0	2	1
9	MC	Environmental Science	2	0	0	0
		Total Credits	**17**	**3**	**6**	**21**

II YEAR **II SEMESTER**

S. No	Course Code	Course Title	L	T	P	Credits
1	ESC	Basic Electrical Engineering	3	1	0	4
2	HSMC	Business Economics and Financial Analysis	3	0	0	3
3	PCC-MM	Heat Treatment and Phase Transformations	3	1	0	4
4	PCC-MM	Principles of Extractive Metallurgy	3	0	0	3
5	PCC-MM	Metallurgical Thermodynamics	3	1	0	4
6	ESC	Basic Electrical Engineering Lab	0	0	2	1
7	PCC-MM	Principles of Extractive Metallurgy Lab	0	0	2	1
8	PCC-MM	Heat Treatment and Phase Transformations Lab	0	0	2	1
		Total Credits	**15**	**3**	**6**	**21**

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
B.TECH. FOUR YEAR DEGREE COURSE
(METALLURGICAL ENGINEEERING)
COURSE STRUCTURE

III YEAR **I SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1	HSMC	Management Fundamentals for Engineers	3	0	0	3
2	PEC-MM	Professional Elective – I	3	0	0	3
3	PCC-MM	Mechanical Metallurgy	4	0	0	4
4	PCC-MM	Iron Making and Steel Making Technologies	4	0	0	4
5	PCC-MM	Materials Processing - I	4	0	0	4
6	PCC-MM	Mechanical Metallurgy lab	0	0	3	1.5
7	PCC-MM	Materials Processing Lab -I	0	0	3	1.5
8	PCC-MM	Fuels Lab	0	0	2	1
		Total Credits	**18**	**0**	**8**	**22**

III YEAR **II SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1	OEC-I	Open Elective - I	3	0	0	3
2	PCC-MM	Non Ferrous Extractive Metallurgy	3	1	0	4
3	PCC-MM	Materials Processing - II	4	0	0	4
4	PCC-MM	Environmental Degradation of Materials	4	0	0	4
5	PEC-MM	Professional Elective – II	3	0	0	3
6	PCC-MM	Materials Processing Lab -II	0	0	3	1.5
7	HSMC	Advanced English Communication Skills Lab	0	0	2	1
8	PCC-MM	Environmental Degradation of Materials Lab	0	0	3	1.5
9	MC	Indian Constitution	2	0	0	0
		Total Credits	**19**	**1**	**8**	**22**

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

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
B.TECH. FOUR YEAR DEGREE COURSE
(METALLURGICAL ENGINEEERING)
COURSE STRUCTURE

IV YEAR **I SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1.	ESC	Introduction to Instrumentation	3	0	0	3
2.	PCC-MM	Materials Characterization Techniques	3	0	0	3
3.	OEC - II	Open Elective – II	3	0	0	3
4.	PEC-MM	Professional Elective – III	3	0	0	3
5.	PEC-MM	Professional Elective – IV	3	0	0	3
6.		Seminar	0	0	2	1
7.		Mini Project	0	0	4	2
8.	Proj-1	Major Project (Phase – 1)	0	0	0	3
		Total Credits	**15**	**0**	**6**	**21**

IV YEAR **II SEMESTER**

S.No	Course Code	Course Title	L	T	P	Credits
1.	OEC-III	Open Elective – III	3	0	0	3
2.	PEC-MM	Professional Elective – V	3	0	0	3
3.	PEC-MM	Professional Elective – VI	3	0	0	3
4.	Project	Major Project (Phase – 2)	0	0	0	8
		Total Credits	**9**	**0**	**0**	**17**

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

MATHEMATICS-I
(Linear Algebra and Calculus)

I Year B.Tech. I-Sem

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge of 12^{th} / 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.
9. Partial differentiation, concept of total derivative
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; Rrank 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

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

References

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint, 2010.

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

L	T	P	C
3	1	0	4

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.

Fibre Optics: Introduction, Principle and Construction of an optical fibre, Acceptance angle, Numerical 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, Magneto striction method, Piezo electric 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:

1. Classical Mechanics by J.C. Upadyaya, Himalaya Publishing House, 2005.
2. Introduction to Solid State Physics by Charles kittel, wiley student edition
3. O. Svelto, "Principles of Lasers".
4. Ajoy Ghatak, "Optics", Mc Graw-Hill Education, 2012

Course Outcomes:

The student will 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

L	T	P	C
3	0	0	3

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 Computers: Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development Method, Algorithms, Pseudo code, flow charts, applying the software development method.

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:

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

Reference Books:

1. C for Engineers and Scientists by H.Cheng, Mc.Graw-Hill International Edition
2. Data Structures using C by A. M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education, PHI
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

L	T	P	C
1	0	4	3

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:

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

UNIT-II

ORTHOGRAPHIC PROJECTIONS:

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

UNIT–III

Projections of Regular Solids – Auxiliary Views.

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:

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

Text Books:

1. Engineering Drawing by N.D. Bhatt, Charotar
2. Engineering Drawing and Graphics by Rane and Shah, Pearson Edu.

Reference Books:

1. A Text Book of Engineering Drawing by Dhawan R K, S. Chand
2. Engineering Graphics with Auto CAD by James D Bethune, Pearson Edu.
3. Engineering Graphics by K R Mohan, Dhanpat Rai.
4. Text book on Engineering Drawing by KL Narayana, P Kannaih, Scitech

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

L	T	P	C
0	0	3	1.5

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

L	T	P	C
0	0	3	1.5

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: $1+x+x^2+x^3+\ldots\ldots\ldots\ldots +x^n$

    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:

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

Reference Books:

1. C for Engineers and Scientists by H.Cheng, Mc.Graw-Hill International Edition
2. Data Structures using C by A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education, PHI
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.

MATHEMATICS-II
(Advanced Calculus)

I Year B.Tech. II-Sem

L	T	P	C
3	1	0	4

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

UNIT-III: Multivariable Calculus (Integration)

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

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

UNIT-IV: Vector Differentiation

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

UNIT-V: Vector Integration

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006

Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002
2. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

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.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Factors affecting in magnitude of splitting. Magnetic and colour properties.

Band structure of solids and effect of doping on conductance. N-doping,P-doping.

Unit-2: Water and its treatment:

Introduction – hardness of water – Causes of hardness. Types of hardness: temporary and permanent. Expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water –Boiler troubles Scale, Sludge, Priming, Foaming and Caustic embrittlement. Treatment. Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water. Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems.

Unit-3: Electrochemistry and corrosion:

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

Causes and effects of corrosion – Theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion. Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of electro chemical corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings –Methods of coating- Hot dipping, cementation – Hot dipping-Galvanization and Tinning. Electroless plating of Copper.

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 alanalysis of n- butane.

Substitution reactions: Nucleophilic substitution reactions: Mechanism of SN1, SN2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using KMnO4 and CrO3.
Reduction reactions: Reduction of carbonyl compounds using LiAlH4 & NaBH4. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

Unit-5: Spectroscopic techniques and applications:
Principles of electronic spectroscopy: Beer's Lamberts law, numerical problems. Types of electronic excitations. Applications of uv-visible spectroscopy. IR Spectroscopy: Principle, modes of vibrations, selection rules, Force constant, some common organic Functional groups wave no. regions (C-H,NH,OH, -COOH, C=0, C≡N, c+C and C≡C) Applications of IR Spectroscopy, H NMR (NMR Spectroscopy) Principle of NMR spectroscopy Chemical shift, chemical shifts of some common organic protons. Introduction to MRI.

Text Books:
1. Text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing company(P)Ltd., New Delhi.

Reference Books:
1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan
3. University Chemistry, by B.H. Mahan
4. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
5. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.

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 pertinate 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

Basic concepts System of Forces- Coplanar Forces – Components in Space – Resultant- Moment of Forces and its Application – Couples and Resultant of Force System - Equilibrium of System of Forces- Free body diagrams-Direction of Force Equations of Equilibrium of Coplanar Systems and Spatial Systems – Vector cross product- Support reactions different beams for different types of loading – concentrated, uniformly distributed and uniformly varying loading.

UNIT – II: FRICTION

Types of friction – Limiting friction – Laws of Friction – static and Dynamic Frictions – Angle of Friction –Cone of limiting friction– Friction of wedge, block and Ladder – Screw jack – Differential screw jack - Motion of Bodies**.**

UNIT – III: CENTROID AND CENTER OF GRAVITY

Centrods – Theorem of Pappus- Centroids of Composite figures – Centre of Gravity of Bodies - Area moment of Inertia: – polar Moment of Inertia – Transfer – Theorems - Moments of Inertia of Composite Figures.

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

Kinetics of a particle – D'Alembert's principle – Motion in a curved path – work, energy and power. Principle of conservation of energy – Kinetics of a rigid body in translation, rotation – work done – Principle of work-energy – Impulse-momentum.

Textbooks:

1. Engineering Mechanics by shames & Rao - Pearson Education.
2. Engineering Mechanics by M.V. Seshagiri rao and Durgaih; University Press.
3. Engineering Mechanics – B. Bhattacharya - Oxford University Publications.

References:

1. Engineering Mechanics (Statics and Dynamics) by Hibbler; Pearson Education.
2. Engineering Mechanics by Fedrinand L. Singer – Harper Collings Publishers.
3. Engineering Mechanics by A. K. Tayal, Umesh Publication.
4. Engineering Mechanics – G. S. Sawhney, Printice Hall of India.
5. A textbook of engineering mechanics by R. K. Bansal; Laxmi publications.
6. Engineering Mechanics by R. S. Khurmi; S. Chand & Co.

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 intergration methods.
4. Understand and know how to solve three-dimension force and moment problems.
5. Understand and know how to use vector terminology.

ENGLISH

I Year B.Tech. II-Sem

L	T	P	C
2	0	0	2

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.

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

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

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 Clichésin 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
Writing: **Technical Reports**- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.
Note: *Listening and Speaking skills which are given under Unit-6 are covered in the syllabus of ELCS Lab Course.*

References:
(i) *Practical English Usage.* Michael Swan. OUP. Fourth Edition 2016.
(ii) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2018.
(iii) *English: Context and Culture* by Board of Editors published by Orient BlackSwan Pvt. Ltd.
(iv) *Remedial English Grammar.* F.T. Wood. Macmillan.2007.
(v) On Writing Well. William Zinsser. Harper Resource Book. 2001
(vi) *Study Writing.* Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
(vii) *Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad.* Oxford University Press

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

L	T	P	C
0	0	3	1.5

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.
13. Determination of surface tension of a give liquid using stalagmometer.
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)
3. Vogel's text book of practical organic chemistry 5th edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

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

L	T	P	C
1	0	3	2.5

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- 1Lecture
3. Tin-Smithy- 1Lecture
4. Black Smithy-1Lecture
5. House-wiring-1Lecture
6. Foundry- 2 Lectures
7. Plumbing-1Lecture

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
2. Elements of Workshop Technology–S. K.Hajra Choudhury and A. K. Hajra Choudhury.

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.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.
Exercise - III
CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

Exercise – IV
CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Making a Short Speech – Extempore.

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.

ICS Lab:

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

L	T	P	C
3	1	0	4

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.
6. Expansion of complex functions using Taylor's and Laurent's series.

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
Introduction, Statistical Inference, Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.
Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Tests Concerning a Single Mean, Tests on Two Means, Test on a Single Proportion, Two Samples: Tests on Two Proportions.

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

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

Reference Books

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

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

L	T	P	C
3	0	0	3

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

Scope and objectives of ore dressing. Sampling of ores by different methods. Theory of liberation of minerals. Crushers: - Jaw, Gyratory, Cone, Rolls and toothed roll crushers. Types of grinding operations- batch and continuous, dry and wet grinding and open circuit and closed circuit grinding. Grinding Mills: Ball mills, theory of ball mill operation, rod and tube mills. Comminution laws: - Rittinger's laws, Kick's law and Bond's law.

UNIT–II

Sizing Techniques: Laboratory and industry practices- Study of laboratory sizing techniques and reporting of sizing data. Types of screens, Movement of solids in fluids: Stokes and Newton's laws. Terminal velocity and its relation with size. Relation between time and velocity. Relation between distance traveled and velocity. Equal settling ratio, Free and hindered settling ratio. Quantifying concentrating operations: Ratio of concentration, recovery, selectivity index and economic recovery.

UNIT–III

Classification and types of classifiers: Study of settling cones, rake classifier, spiral classifier and cyclones. Heavy media separation: Principles, flow chart, different media used. Heavy media separation using heavy liquids and heavy suspensions. Washability curves of coal. Jigging: Theory of jigging and Jigging machines, Harz, Baum, Denver jig. Design considerations in a jig.

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

Floatation: Principles of floatation. Factors affecting floatation. Classification of collectors and frothers. Regulators, factors affecting their efficiency. Floatation machines: Pneumatic and mechanical floatation cells. Application of floatation process to Cu, Pb and Zn ores.

Text Books:

1. Principles of Mineral Dressing by A.M. Gaudin.
2. Mineral processing technology - A. Wills.

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

L	T	P	C
3	1	0	4

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

Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume-Rothery's rules. Intermediate alloy phases, electron-chemical compounds, and electron phases.

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-Fe_3 C, Cu-Zn, Cu-Sn, Pb-Sn, Al-Cu and complex phase diagrams.

Text Books:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL,1997.

Reference Books:

1. Physical Metallurgy Principles- R.E. Reed Hill.
2. Physical Metallurgy - V. Raghavan.
3. Physical Metallurgy - Vijendra Singh
4. Foundations of Materials Science and Engineering – WF Smith.
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-Fe_3C 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

L	T	P	C
3	1	0	4

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 Zeroth 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 ΔG 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 ΔS^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.
2. Thermodynamics of solids- R.S. Swalin.
3. Physical chemistry of metals- L.S. Darken & Gurry.
4. Problems in Metallurgical Thermodynamics : G.S Upadhyaya, R.K. Dubey.

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 1^{st} and 2^{nd} 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

L	T	P	C
3	0	0	3

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:

1. S.K. Jain - Metallurgical analysis.
2. Agarwal, B.C. and Jain S.P., A Text Book of Metallurgical Analysis, Khanna Publishers, Delhi -1963.

Reference Books:

1. Iyer V.G., Metallurgical Analysis: BHU Press, Varanasi.
2. Snell Foster D and Frank M Biffen: Commercial methods.of analysis / Che. Publishing Co.,1964.
3. Vogel Al., A Text Book of Quantitative Inorganic Analysis Longman ELBS 1962.
4. Willard H.H.etal: Instrumental Methods of analysis Van Nostrand.

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

L	T	P	C
0	0	2	1

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.
9. Study of a jig machine.
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

L	T	P	C
0	0	2	1

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.
3. Metallographic preparation and microstructure evaluation of low carbon steel.
4. Metallographic preparation and microstructure evaluation of medium carbon steel.
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.
8. Metallographic preparation and microstructure evaluation of Brass.
9. Determination of phase fraction and grain size using Image analyzer.
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

L	T	P	C
0	0	2	1

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:

1. Estimation of Iron in Iron ore by $KMnO_4$ method.
2. Estimation of Iron in Iron ore by $K_2Cr_2O_7$ method.
3. Estimation of lime in Limestone.
4. Estimation of Silicon in Cast Iron.
5. Estimation of manganese in cast iron.
6. Estimation of Sulphur and Phosphorus in cast irons.
7. Estimation of Chromium in Steel.
8. Estimation of Carbon in Steel by Strohlein apparatus method.
9. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
10. Estimation of the concentration of $KMnO_4$ 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

L	T	P	C
2	0	0	0

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

ECO SYSTEMS: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features. structure and function of the following ecosystem: a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT - III

BIODIVERSITY AND ITS CONSERVATION: Introduction - Definition: genetic, species and ecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels. - India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. -Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

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.

Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montreal Protocol.

UNIT - V

SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development -Urban problems related to energy - Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its

problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. - Wasteland reclamation. - Consumerism and waste products. - Environment Protection Act. - Air (Prevention and Control of Pollution) Act. - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation. - Public awareness.

HUMAN POPULATION AND THE ENVIRONMENT: Population growth, variation among nations. Population explosion - Family Welfare Programme. -Environment and human health. -Human Rights. -Value Education. - HIV/AIDS -Women and Child Welfare. -Role of information Technology in Environment and human health. — Case Studies.

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

L	T	P	C
3	1	0	4

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

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

Transformers: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

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:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. S.L. Uppal and G C Garg “Electrical Wiring Estimating & Costing”, Khanna Publishers 6th edition, 1987.

Reference Books:

1. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
2. J B Gupta “Electrical Installation Estimating and Costing” S. K. Kataria & Sons, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

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- I: Introduction to Engineering Economics- Basic Principles and Methodology of Engineering Economics– Fundamental Concepts - Demand – Demand Determinants - Law of Demand- Demand Forecasting and Methods - Elasticity of Demand - Theory of Firm – Supply- Elasticity of Supply.

Unit- II: Macro Economic Concepts: National Income Accounting - Methods of Estimation- Various Concepts of National Income - Inflation – Definition – Causes of Inflation and Measures to Control Inflation - New Economic Policy 1991 (Industrial policy, Trade policy, and Fiscal policy) Impact on Industry.

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

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

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.

Unit- V: Introduction to Accounting: Accounting Principles (GAPP), concepts, conventions- - Double entry system of Book keeping – Accounting rules- Journal- ledger- Trial balance- Trading and Profit and Loss account- Balance Sheet. (Simple Problems).

Suggested Readings:

1. Henry Malcom Steinar-Engineering Economics, Principles, McGraw Hill Pub.
2. D.D.Chaturvedi, S.L.Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
3. Jain and Narang" Accounting, Kalyani Publishers.
4. Arora, M.N." Cost Accounting, Vikas Publication.
5. S.N.Maheshwari, Financial Management, Vikas Publishing House.

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

L	T	P	C
3	1	0	4

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

Principles of Heat Treatment of steels**.** Formation of Austenite on heating, Austenitic grain size, determination and decomposition of austenite. TTT and CCT curves. Effect of alloying elements on TTT curves and Fe-Fe_3C diagram. Phase Transformations: Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation, Order-disorder transformation, Spinodal decomposition.

UNIT-II

Annealing, Normalizing, Hardening and tempering. Mechanism of heat removal during quenching, quenching media, size effect and mass effect. Tempering and its stages, Austempering, Martempering, Subzero treatment, Patenting. Hardenability of steels, Factors affecting and its determination.

UNIT-III

Surface Heat Treatment: Principles and Applications of Carburizing, Nitriding, Carbonitriding, Nitrocarburizing, Boronizing and Aluminizing. Thermal Surface Modification Processes- Flame, Induction and Laser hardening. Thermo mechanical treatments: HTMT, LTMT, Ausforming, Isoforming, Cryoforming.

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:

1. Heat Treatment Principle and Techniques - Rajan & Sharma.
2. Phase Transformations in Metals and Alloys - D. A . Porter and K.E. Esterling.

Reference Books:

1. Heat Treatment of Metals by Vijendra Singh
2. Physical Metallurgy – Lakhtin.
3. Physical Metallurgy - Clark and Varney.
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

L	T	P	C
3	0	0	3

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

Introduction: Classification of ores. Basics of Pyrometallurgy, Calcination, Roasting and types of roasting- Oxidising, sulphatising, and chloridizing. Simple equations/reactions. Roasting furnaces: Multiple hearth roaster, flash roasting, fluidized bed roasting and blast roasting.

UNIT-II

Pelletisation and Sintering. Smelting: Principles of reduction and matte smelting with examples. Smelting furnace: Reverberatory, BF and electric smelting. Flash smelting.
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, liquation, electro-refining and zone refining with some examples.

Text Books:

1. Non-ferrous extractive metallurgy: H.S.Ray, K.P.Abraham and R.Sreedhar.
2. Principles of extractive metallurgy - H.S. Ray & A. Ghosh.

Reference Books:

1. A text book of metallurgy - A.R.Bailey.
2. Principles of extractive metallurgy - A.K. Ghosh.
3. Principles of extractive metallurgy - Terkel Rosenqvist, Tapir Academic Press, 2004.

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

L	T	P	C
3	1	0	4

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.
4. Knowledge of ideal and regular solutions and free energy of mixing.
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

L	T	P	C
0	0	2	1

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.
6. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits.
7. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer.
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).
10. Measurement of Active and Reactive Power in a balanced Three-phase circuit.
11. Performance Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
12. Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
13. Performance Characteristics of a Three-phase Induction Motor.
14. Torque-Speed Characteristics of a Three-phase Induction Motor.
15. No-Load Characteristics of a Three-phase Alternator.

- 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
0	0	2	1

Pre-Requisites: Principles of Extractive Metallurgy

Course Objectives:

1. This is course is design 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

L	T	P	C
0	0	2	1

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.
2. Normalizing 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.
6. Effect of tempering time on plain carbon steel.
7. Age hardening of Aluminium alloy or Copper alloy.
8. Spheroidizing of a given high carbon steel.
9. Surface hardening of plain carbon steel.
10. Determination of hardenability of medium carbon steel by Jominy end quench test.
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

L	T	P	C
3	0	0	3

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

Human Resource Management - HR Planning - Recruitment & Selection - Training & Development-Performance appraisal - Job satisfaction - Stress Management Practices

Unit –III

Operation Management: Introduction to Operations Management - Principles and Types of Plant layout - Methods of production (Job Batch and Mass production) - Method study and Work measurement - Quality Management - TQM-Six sigma - Deming's Contribution to Quality - Inventory Management – EOQ - ABC Analysis - JIT System-Business Process Re-engineering (BPR)

Unit-IV

Marketing Management: Introduction to Marketing-Functions of Marketing-Marketing vs. Selling-Marketing Mix - Marketing Strategies - Product Life Cycle - Market Segmentation -Types of Marketing - Direct Marketing-Network Marketing - Digital Marketing-Channels of Distribution - Supply Chain Management (SCM)

Unit-V

Project Management: Introduction to Project Management-steps in Project Management - Project Planning - Project Life Cycle-Network Analysis-Program Evaluation & Review Technique (PERT)-Critical Path Method (CPM) - Project Cost Analysis - Project Crashing - Project Information Systems

Suggested Readings:

1. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.
3. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
4. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
5. Industrial Engineering and Management: Including Production Management, T.R.Banga, S.C Sharma, Khanna Publishers.

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)

III Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

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

Introduction to Fuels technology: Classification of fuels, Origin and classification of coal, Proximate and ultimate analysis of coal and its applications. Properties and uses of Pulverized coal, Carbonization of coal and types of Carbonization. Properties, uses and testing of Metallurgical Coke.
Liquid fuels: Properties and applications.

UNIT –II

Manufacture, properties and uses of Producer gas and Water gas.
Modes of heat transfer, Importance of heat transfer. Steady State Heat Transfer: Conduction through plane, cylindrical, Spherical and compound walls, shape factor and effect of variable thermal conductivity. Dimensional groups. Free and forced convection. Heat transfer by combined effect of conduction and convection between two fluids separated by a plane wall and cylindrical wall.

UNIT-III

Furnaces: Classification and uses of furnaces, characteristic features of Vertical Shaft furnaces,
Reverberatory furnaces, Arc and Induction furnaces, Tube and Muffle type Resistance furnaces, Continuous furnaces. Heat losses in furnaces and heat balance. Waste heat utilization methods: Simple working of recuperators and regenerators.

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:

1. Fuels, Furnaces and Refractories – O.P. Gupta, Khanna Publishers.
2. Metallurgical furnaces – Krivadan and Markov.

Reference Books:

1. Elements of fuel technology – HIMUS.
2. Furnaces -J. D. Gilchrist.
3. Pyrometry -W.P. wood & J. M. Corck.
4. Elements of heat transfer - Jakob & Hawikns.
5. Elements of thermodynamics & heat transfer - Obert & Young.
6. Control systems & Instrumentation – S. Bhasker.

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

L	T	P	C
3	0	0	3

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

Introduction, Importance of Nano-technology, Emergence of Nano-Technology, Bottom-up and Top-down approaches, challenges in Nano Technology.

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

One Dimensional Nano-structures: Nano wires and nano rods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization.

Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electro-spinning and Lithography.

UNIT-IV

Two dimensional Nano-Structures, Fundamentals of film growth. Physical vapour Deposition (PVD): Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering.

Chemical Vapour Deposition (CVD): Typical chemical reactions, Reaction kinetics, transport phenomena, CVD methods, diamond films by CVD.

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:

1. Nano Materials: A. K. Bandyopadyay, New age Publications.
2. Nano Essentials: T. Pradeep, TMH.

Reference Books:

1. Springer Handbook of Nanotechnology.
2. The Guest for new materials Auther S. T. Lakshmi Kumar, Published by Vigyan Prasar.
3. Nano – The Essentials: C – Pradeep (IIcue Professor), McGraw Hill.
4. Nano Materials Synthesis, Properties and applications, 1996, Edlstein and Cammarate.

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

L	T	P	C
3	0	0	3

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: The C programming language, GNU plot – the plotting freeware, GNU Octave for computations and plotting, Introduction to FEM, FDM, FVM and Computer packages: MATLAB, Sci Lab. Plotting, Fitting, Interpolation, Numerical integration, Numerical differentiation.

UNIT-II

Structure and Thermodynamics: Basics of Mathematical Modelling-Deterministic and stochastic / probabilistic models. Structure and defects. Computing free energy of common metallurgical systems from enthalpy and entropy or heat capacity and determination of temperature of reduction of metal oxides. Regular solution model.

UNIT- III

Phase Transformations: Mathematical formulation of Solid state processes of Heat treatment & Microstructure evolution, Diffusion and precipitate growth kinetics. Transport phenomena based Modelling: model formulation based on heat, mass and momentum transfer, governing equations and boundary conditions. Spinodal decomposition, Classical Molecular Dynamics Modelling and simulations and its applications in materials, Monte Carlo simulations: phase separation and ordering.

UNIT-IV

Phase-Field and Heat-Mass Transfer: Mathematical formulation of Liquid state Metallurgical Processes of Iron Making, Primary Steel Making and Secondary Steel Making using Momentum, Mass and Energy Balance. Principles of Computational Fluid flow and setting up the governing equation with boundary conditions. Formulation of Laminar and Turbulent flows. Case Studies of Tapping of Liquid steel, melting behaviour of additions, IGP. Computation of % CO/CO_2 at different heights with a given function of temperature profile along the height of BF and Simulations of Blast furnace reduction reactions at various heights. Mathematical Modeling of Solidification of Steel in Sand Moulds, Ingot Moulds & Concast.

UNIT-V

New approach: Optimization and control. Elements of modern artificial intelligence (AI) related techniques. Introduction to Genetic Algorithm and Artificial Neural Nets. Dis-critized Methods of Taylor's series expansion, polynomial Interpolation and least square approximation for numerical computation of Non linear algebraic equations, ODE & PDE. Statistical methods for validating models.

Text Books:

1. Introduction to Computational Materials Science – Richard LeSar, Cambridge University Press (2013).
2. Applied numerical methods for engineering using matlab and C – R.J. Schilling and S.L. Harris, Cengage Learning (2007).

Reference Books:

1. Mathematical Methods for Physics and Engineering, 3rd Edition – R.F. Riley, M.P. Hobson, S.J. Bence, Cambridge University Press (2012).
2. Modeling in materials processing – J.A. Dantzig and C.L. Tucker III, Cambridge University Press (2001).
3. V Raghavan, "Materials Science and Engineering", Prentice-Hall India, 2004.
4. E Kreyzig, "Advanced Engineering Mathematics", Wiley-India,1999.
5. Dipak Mazumdar, James W. Evans, "Modelling of Steel Making Processes", CRC Publication,1st Edition, 2010.
6. H.K.Versteeg , W. Malalsekera, "An Introduction to Computational Fluid Dynamics", Longman Scientific and Technical, 1st Edition 1995.
7. S.C.Chapra, R.P.Canale, "Numerical Methods for Engineers", McGraw Hill India Pvt. Ltd.,5th Edition, 2002.
8. S. Yip (Ed.): Handbook of Materials Modelling, Springer, 2005.
9. Santosh K. Gupta: Numerical Methods for Engineers, New Age International (P) Limited, New Delhi, 1998.

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

L	T	P	C
4	0	0	4

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 back ground 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

Metallurgical fundamentals: Defects in crystalline materials – Point defects and line defects. The concept of dislocations, edge dislocation and screw dislocation. Slip and twinning. Interaction between dislocations, sessile dislocation, glissile dislocation, energy of a dislocation, dislocation climb, Jogs, forces on dislocations. Frank Reed source, Critical resolved shear stress.

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

The Tension Test: Mechanism of classic action, linear elastic properties. Engineering stress-strain and True stress-strain curve. Tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties. Elastic and in-elastic action and properties in compression test.

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

Fatigue Test: Introduction, Stress cycles, S-N Curve, mechanism of fatigue failure, effect of mean stress, stress concentration, size, surface condition and environments on fatigue. Effect of metallurgical variables on fatigue. Low-cycle fatigue. High-cycle fatigue and thermal fatigue.

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:

1. Mechanical Metallurgy – G. E. Dieter.
2. Engineering Materials Science – C. W. Richards.

Reference Books:

1. Mechanical behavior of material - A. H. Courteny.
2. Mechanical behavior - Ed. Wulf.
3. Mechanical Metallurgy – White & Lemay.

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

L	T	P	C
4	0	0	4

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_2O 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

Classification and raw materials of steel making. Principles of Steel making, Removal of carbon, silicon, manganese, phosphorous and sulphur. Role of slag, types and properties of slags. Principles and types of deoxidation.

UNIT-V

Steel making by Bessemer, Open Hearth and Electric arc furnace processes. Basic oxygen steel making: LD, LDAC, Kaldo, and Rotor oxygen steel making. Hybrid process of steel making LD-KG, CLU, MRP. Ingot casting (Conventional casting).

Text Books:

1. A first course in iron and steel making, Dipak Mazumdar, Orient Blackswan Pvt. Ltd., (2015).
2. Iron making and steelmaking: Theory and Practice, Ghosh Ahindra, Chatterjee Amit, PHI Learning Private Limited, (2001).

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.,).
4. An introduction to modern steel making, R. H. Tupkary, Khanna Publishers (2000).
5. An introduction to modern iron making, R. H. Tupkary, Khanna Publishers (2004).

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, CO_2 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

Melting and Solidification: Cupola and Induction Melting. Progressive and Directional Solidification. Classification of welding processes: Principles, advantages, disadvantages and fields of application of the following welding processes: Gas Welding, Arc Welding processes, MMAW, GTAW, MIG, SAW and Resistance Welding

UNIT- IV

Metal Joining Techniques: Principles, advantages, disadvantages of Thermit welding, Electron Beam Welding, Laser welding, Solid state welding, Friction stir welding processes, Ultrasonic welding, Explosive welding.

UNIT-V

Microstructure of fusion zone and heat affected zone. Influence of heat input, thermal and residual stresses, pre heat and cooling rate, PWHT. Problems during welding of carbon steels and Remedies, Welding Defects.

Text Books:

1. Principles of Metal casting by Heine – Loper and Rosenthal, Tata McGraw Hill, 2nd Edition.
2. Welding Technology – O.P. Khanna.

Reference Books:

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Foundry Technology – Dharmendra Kumar & S.K.Jain, CBS Publisher, 2007.
3. Manufacturing Technology – Vol. I: Foundry, Forming and Welding, P.N.Rao, McGraw Hill 3rd Edition.
4. Casting Technology and Cast Alloys – AK Chakrabarti – PHI 2011 Edition.
5. Castings – John Campbell – Second Edition – Elsevier.
6. Welding Metallurgy - JF Lancaster.
7. Welding and Welding Technology – Little.

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

L	T	P	C
0	0	3	1.5

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
0	0	3	1.5

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

L	T	P	C
0	0	2	1

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.
6. Determination of Flash and Fire points of kerosene 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

L	T	P	C
3	0	0	3

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

Ceramic Materials: Introduction, Properties and Applications of Ceramics, Glasses and Refractories.

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:

1. W.F.Smith, Principles of Materials Science and Engineering, Mc Graw Hill, New York, 1994.
2. William D. Callister Introduction to Material Science and Engineering, John Wiley and Sons, 2007.

Reference Books:

1. Donald R. Askland, Pradeep P. Phule, The Science and Engineering of Materials (4th Edition), Thomson Publishers, 2003.
2. Engineering materials - R.K. Rajput.
3. Engineering materials - Michael F. Ashby and David R.H.Jones.

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

L	T	P	C
3	0	0	3

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

Heat Treatment of Steels: The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering.

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

Testing of Metals: Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

Text Books:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997.

Reference Books:

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006.
3. Foundations of Materials Science and Engineering – WF Smith.
4. Metallurgy for Engineers- Clark and Varney.
5. Mechanical Metallurgy – G. E. Dieter.

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

Aluminium: Bayer process: Hall - Heroult process: Anode effect: Efficiency of the process: Refining, Alternative processes of aluminum production.

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 UO_2 and uranium.

Simplified flow sheets for the extraction of nickel, tungsten and gold. Review of non-ferrous metal industries in India.

Text Books:

1. Extraction of Non-Ferrous Metals - HS Ray, KP Abraham and R. Sridhar.
2. Metallurgy of Non-Ferrous Metals - WH Dennis.

Reference Books:

1. Rare Metals Hand book - C.A. Hampel.
2. Nuclear Reactor General Metallurgy - N. Sevryukov, B. Kuzmin and Y. Chelishchevr.
3. Nuclear Chemical Engineering - Manstion Bendict and Thomas H. Pigfort.

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

L	T	P	C
4	0	0	4

Pre-Requisites: Nil

Course Objectives:

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

UNIT-I

Stress and Strain relationship for elastic behavior: Description of stress at a point. State of stress in two dimensions. Mohr's circle of stress in two dimensions, state of stress in three dimensions. Mohr's circle of stress in three dimensions, description of strain at point.

Elements of Theory of Plasticity: The flow curve. True stress and true strain. Von-Mises distortion energy criterion, maximum shear stress or Tresca criterion. Octahedral shear stress and shear strain. Basics of the theories of plasticity.

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.

Extrusion: Classification of extrusion processes, extrusion equipment. Hot extrusion. Deformation and defects in extrusion. Analysis of the extrusion process. Cold extrusion. Extrusion of tubing and production of seamless pipe and tubing.

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:

1. Mechanical Metallurgy by GE Dieter (3rd edition).
2. Mechanical working of metals - Avitzone.

Reference Books:

1. Engineering Metallurgy – Part-II – Higgins.
2. Mechanical behavior - Ed. Wulf.
3. Mechanical Metallurgy – White & Lemay.

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.

ENVIRONMENTAL 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

Corrosion prevention methods: Alteration of Environment (Inhibitors), Design, Coatings, cathodic and anodic protection. Material selection, Metallurgical aspects, Hydrogen damage (hydrogen blistering, Hydrogen embrittlement, Prevention).

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:

1. Corrosion Engineering – Fontana.
2. Electrometallurgy- Blum.

Reference Books:

1. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.
2. Corrosion Engineering 1st Edition Principles and Solved Problems by Branko Popov.
3. Handbook of Corrosion Engineering, Second Edition by: Pierre R. Roberge, Ph.D.

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.

Sponge Iron making: Introduction, process of making sponge iron, properties and uses of sponge iron; sponge iron process: Coal based process rotary kiln. Gas based process: HYL process (HYL-III and HYL – IVM process).

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

Modern steel making: Principles of steel making, Oxygen steel making processes: LD and LD – AC. Top and Bottom blown converter process: LD-AD, LD-OD.

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:

1. Iron Making & Steel Making theory and practice, A. Ghosh and A. Chatterjee, Prentice-Hall of India pvt. ltd: 2008
2. Sponge Iron Production by Direct Reduction of Iron Oxide, Amit Chatterjee, PHI Publications, New Delhi.

Reference Books:

1. Principles of Blast furnace Iron Making, A. K. Biswas, SBA Publication, 1999.

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

L	T	P	C
3	0	0	3

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

Types of reinforcements and their properties: Glass, Carbon, Boron, Aramid, Al_2O_3 and SiC fibers. Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial and bond strength.

UNIT-III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications. Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites, Applications of Ceramic Matrix Composites.

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

Micro and macro mechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

Text Books:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

Reference Books:

1. Composites, Engineered Materials Handbook, Vol.1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994.

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)

III Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

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 (ε - k diagram, a parabola), k-space; Density-of states [g(ε)]; 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 ε - k diagram; Allowed number of states in a band.

UNIT-II

Electron Dynamics: Group-velocity, electron dynamics from ε - 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, magnetorestriction; 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, hysterisis and ferroelectric domains; Applications in sensors, actuators and memory devices.

UNIT -V

Manufacturing of Electronic Materials: Introduction to semiconductor manufacturing. History, overview of process flow, manufacturing goals. Scaling. Wafer manufacturing. Si ingot preparation. Poly to single crystal conversion. Czochralski vs. float zone method. IC device manufacturing overview. Thermal oxidation. Doping. Lithography. Etching and growth. Metallization and growth.

Text Books:

1. Electronic Properties of Materials: An Introduction for Engineers, Rolf E. Hummel, Springer Verlag, 1985
2. Physical Properties of Semiconductors, Charles M. Wolfe, Nick Holonyak and Gregory E. Stillman, Prentice Hall, 1989
3. Semiconductor Materials, Devices and Fabrication, Parasuraman Swaminathan, Wiley 2017

Reference Books:

4. Principles of Electronic Materials and Devices, S. O. Kasap, McGraw Hill Education, 2017.
5. Electronic Materials by Chelikowsky, James R., Franciosi, Alfonso (Eds.).
6. Electronic Materials and Processes Handbook by Charles Harper.

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

L	T	P	C
0	0	3	1.5

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.

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

III Year B.Tech. II-Sem

L	T	P	C
0	0	2	1

1. Introduction

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

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

- Gathering ideas and information to 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.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing –improving one's writing.

4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. Minimum Requirement:

The Advanced 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**
- **P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ**
- **T. V, a digital stereo & Camcorder**
- **Headphones of High quality**

5. 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:

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

ENVIRONMENTAL DEGRADATION OF MATERIALS LAB

III Year B.Tech. II-Sem

L	T	P	C
0	0	3	1.5

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

L	T	P	C
2	0	0	0

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.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- 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.
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
3. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
4. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

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

L	T	P	C
3	0	0	3

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

Electronic Instruments: CRO- Storage oscilloscope – Digital voltage meter (DVM) –Digital multi meter – XY Recorder, Strip chart recorder – Digital recording- Data logger – Introduction to virtual instrumentation.

UNIT-II

Pressure Measurements: Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges – Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge.

UNIT-III

Flow Measurements: Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rota meter – Mass flow meters.

UNIT-IV

Vibration, Viscosity, Humidity, Level Measurement: Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer- Vibrometers – Viscosity – Saybolt viscometer. Humidity – Hot wire electro type hygro meter - Dew cell – Electrolysis type hygrometer.

UNIT- V

Analyzers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyzer – Sodium analyzer – Silica analyzer – Turbidity meter – Gas analyzer – NOx analyzer – H_2S analyzer – CO and CO_2 monitor, Dust & Smoke measurement.

Text Books:

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

Reference Books:

1. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
2. Patranabir, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
3. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi,1999.
   Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co.,1994 .

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

L	T	P	C
3	0	0	3

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

Scanning Probe Microscopy (SPM) Introduction, Instrumentation, Scanning Tunneling Microscopy-Basics, Probe Tips, Working environment, operational modes, Applications, Limitations.

Atomic Force Microscopy (AFM) – Basic Principles, instrumentation, operational modes, Applications, Limitations.

Text Books:

1. V.T. Cherapin and A.K. Mallik: Experimental Techniques in Physical Metallurgy, Asia Publishing House, 1967.
2. Robert F. Speyer: Thermal Analysis of Materials, Marcel Dekker Inc., New York, 1994.

Reference Books:

1. S.J.B. Reed: Electron Microprobe analysis, Cambridge University Press, London, 1975.
2. ASM Hand book: Materials Characterization, ASM International, 2008.

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

L	T	P	C
3	0	0	3

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

Corrosion prevention methods: Alteration of Environment (Inhibitors), Design, Coatings, cathodic and anodic protection. Material selection, Metallurgical aspects, Hydrogen damage (hydrogen blistering, Hydrogen embrittlement, Prevention).

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:

1. Corrosion Engineering, M. G. Fontana, 3rd edition, McGraw-Hill, 1985.
2. Corrosion and Corrosion Control, H. H. Uhlig, Wiley, 1985.

Reference Books:

1. Theory of Corrosion and Protection of Metals, N. D. Tomashov, Macmillan, 1967.
2. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.
3. Corrosion Engineering 1st Edition Principles and Solved Problems by Branko Popov.
4. Handbook of Corrosion Engineering, Second Edition by: Pierre R. Roberge, Ph.D.

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, pourbiax extrapolation techniques.

TESTING OF MATERIALS
(Open Elective- II)

IV B.Tech. I-Semester

L	T	P	C
3	0	0	3

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

The Tension Test: Engineering stress-strain and True stress-strain curves. Tensile properties, conditions for necking. Stress-Strain diagrams for Steel, Aluminum and Cast Iron.

UNIT-III

Fatigue Test: Introduction, Stress cycles, S-N Curve, Effect of mean stress, mechanism of fatigue failure, effect of stress concentration, size, surface condition and environments on fatigue.

UNIT–IV

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.

UNIT–V

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

Text Books:

1. Mechanical Metallurgy – G. E. Dieter, Third edition, published by Newyork Mc Graw Hill,1986.
2. Mechanical behavior - Ed. Wulf.

Reference Books:

1. Mechanical Metallurgy – White & Lemay.
2. Testing of Metallic Materials - A.V.K. Suryanarayana.

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

L	T	P	C
3	0	0	3

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

Alpha Ti alloys, Beta Ti-alloys, Alpha plus Beta Ti alloys, Ti-6Al-4V, Ti-8Al-1Mo-1V, Ti-13V-11Cr-3Al alloys. Heat treatment and thermomechanical processing of alpha, alpha-beta and beta titanium alloys.

UNIT-V

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

Text Books:

1. Light alloys: Metallurgy of the light metals by I. J. Polmear.
2. Introduction to Physical Metallurgy – S.H. Avner.

Reference Books:

1. Heat treatment, structure and properties of Non ferrous alloys - Charlie Brooks, ASM Metals Park, Ohio, USA.
2. Engineering Physical Metallurgy – Lakhtin.
3. ASM Metals Handbook Vol-1 & 2.
4. Metallurgical abstracts on light metals and alloys Keikinzoku Shōgakukai, Light Metal Educational Foundation., 1999.

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)

IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

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

Crack initiation, propagation and fracture, Mechanisms of fracture. Macrostructural and microstructural aspects, Use of fracture mechanics in fatigue.

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

Elementary theories of fracture, Griffith's theory of brittle fracture, Strain-Energy Release Rate , Stress Intensity Factor, Fracture Toughness and Design, K_{IC} Plane-Strain Toughness Testing, Plasticity Corrections, Crack Opening Displacement, J-Integral, R Curve, Probabilistic Aspects of Fracture Mechanics, Toughness of Materials.

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

Text Books:

1. Fatigue of Materials, Suresh, Cambridge India, 2015.
2. Fracture Mechanics, Fundamentals and Applications, T.L. Anderson, CRC Press 2017.

Reference Books:

1. Ewalds, H.L., R.J.H. Wanhill (1986). Fracture Mechanics, Edward Arnolds; USA.
2. R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons, 1976, p 229–230.

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.
3. Knowledge of connecting fracture mechanics concepts to fatigue failure.
4. Knowledge of fatigue failure mechanisms in metallic and non-metallic materials.
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

L	T	P	C
3	0	0	3

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:

1. Failure Analysis of Engineering Materials, Charles Brooks, Ashok Choudhury, Charlie R. Brooks, McGraw-Hill Education; 2001.
2. Metallurgical Failure Analysis: Techniques and Case Studies Author(s): KannadiPalankeezhe Balan, ISBN: 978-0-12-814336-0.

Reference Books:

1. Failure Analysis: Fundamentals and Applications in Mechanical Components, Jose Luis Otegui, Springer, 2016.
2. Failure Analysis of Engineering Materials (Mcgraw - Hill Professional Engineering) by Charles R Brooks and Ashok Choudhury.
3. Failure Analysis Case Studies: A Source Book of Case Studies Selected from the Pages of Engineering Failure Analysis 1994-1996 by D R H Jones.

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

L	T	P	C
3	0	0	3

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

Thermo-chemical Processes: carburizing, nitriding, carbo-nitriding, nitro carburizing, Boronising, Plasma nitriding, thermal spraying, Plasma spraying, Alumnizing.

UNIT-IV

Thermal Processes: Flame hardening, induction hardening, laser hardening, laser surface alloying, laser cladding, electro-beam hardening.

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:

1. Advanced thermal assisted surface engineering processes, Ramnarayan Chattopadhyay, published by Kluwer Academy Publishers 2004.
2. Surface engineering of metals: principles, Equipment and techniques, Tadeusz Burokowski, Tadeusz Wierzchon, CRC Press 1998.

Reference Books:

1. Advanced techniques for surface engineering, W. Gissler, Herman A. Jehn, published by Kluwe Academy Publishers in 1992.
2. Laser material processing, William M. Steen, fourth edition, Springer.

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

L	T	P	C
3	0	0	3

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 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:

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2004.
2. Energy Materials by Duncan W. Bruce, Dermot O'Hare, Richard I. Walton.

Reference Books:

1. Materials Science in Energy Technology 1st Edition by G Libowitz.
2. Advanced Energy materials 1st Edition by Ashutosh Tiwari, Sergiy Valyukh.
3. Energy Storage & Conversion: Materials & Devices by A. Kumar, S. K. Das.

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

L	T	P	C
3	0	0	3

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.
2. Ultrasonic Testing of Metals; J Krantkramer and H. Krantkramer, Spinger Vekg, 1987.

Reference Books:

1. Testing of Materials by A. V. K. Suryanarayana.
2. Metals Handbook Vol. II, Nondestructive inspection and quality control.
3. R. C. McMaster, Ed., Nondestructive Testing Handbook (American Society for Nondestructive Testing, The Ronald Press Co., New York, 1959), vol I & II.
4. J. F. Himsley, Non-destructive Testing, Macdonald and Evans, London, 1959.

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.

SEMINAR

IV Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

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

L	T	P	C
0	0	4	2

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

L	T	P	C
0	0	0	3

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

L	T	P	C
3	0	0	3

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

Classification of Steels. Advantages and limitations of Plain carbon steels. Alloy steels classification, purpose and general effects of alloy elements in steels. Cold forming steels, High strength packing steels; HSLA steels; Low-carbon Ferrite pearlite steels, structure property relationships, strengthening mechanisms, Formability of HSLA steels.

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:

1. Physical Metallurgy and the Design of steels: F. B. Pickering, Applied Science publisher, London, 1978.
2. The physical Metallurgy of steels: W. C. Leslie by Hempisphere Publishers Corporation, 1981.

Reference Books:

1. Alloys Steels – Wilson.
2. Heat Treatment of steels – Rajan & Sharma.

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

L	T	P	C
3	0	0	3

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

Creep, Types of Creep, Testing methods, Creep data presentation, Creep Curve and stages of creep, Mechanisms of Creep and creep resistant steels.

UNIT-II

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

UNIT-III

Oxidation, Kinetics of oxidation, Factors controlling oxidation, Hot Corrosion, Testing methods, Mechanisms of hot corrosion, erosion, Hot corrosion properties of carbon steels and stainless steels.

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:

1. Evans, R.W and Wilshire, B. Creep of metals and alloys, Institute of metals, 1985, London.
2. J.R. Davis, ASM Specialty Handbook: Heat- resistant materials, ASM, 1997.

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)
2. The Super-alloys: Fundamentals and Applications, Roger C. Reed, Cambridge University Press; 1 edition (July 31, 2008)
3. High Temperature Coatings, Sudhansu Bose, Butterworth-Heinemann; 1 edition (February 6, 2007)
4. Polyimides and Other High Temperature Polymers: Synthesis, Characterization and Applications, K. L. Mittal, Brill Academic Publications, 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

L	T	P	C
3	0	0	3

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:

1. J F Lancaster, Physics of welding, Pargamon press, 1986.
2. R. W. Heine, C. R. Loper, P. C. Rosenthal: Principles of metal casting, Mc Graw Higher Ed 1976.

Reference Books:

1. W. Kurz and D.J. Fisher, Fundamentals of Solidification, CRC Press, 1998.
2. John Campbell, castings, Butterworth Heinemann, edition-1, 1998.
3. Doru Micheal stefanescu-Science and engineering of casting Solification, Second Edition (2008)
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

L	T	P	C
3	0	0	3

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

Definition and classification of materials, comparison of properties of metals and nonmetallic materials. Nature of bonding.

UNIT-II

Ceramics: Structure, defects. Ionic and semiconducting behavior. Processing techniques. Glasses and glass-ceramics, glass fibres. Structural ceramics: fracture toughness, toughening mechanisms. Special ceramics: Electro-optic, dielectric, ferroelectric, piezoelectric, magnetic, superconducting, laser and dilute magnetic and bio-ceramics.

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

Textiles. Adhesives, and Foams: Introduction, classification and applications of textile materials. Structure of Adhesives and their applications. Classification and applications of foam materials, Manufacturing methods of industrially important adhesives and foams.

Text Books:

1. Textbook of Polymer Science; Fred W. Billmeyer, Wiley 2007.
2. Introduction to Ceramics; Kingery, Bowen, Uhlman. Wiley India Pvt Limited, 2012.

Reference Books:

1. Science and Engineering; Krishan K. Chawla, Springer, 2012.
2. W.S. Smith: Principles of Materials Science and Engineering, McGraw-Hill.
3. V. Raghavan: Materials Science and Engineering, Prentice-Hall.

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

L	T	P	C
3	0	0	3

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

Characteristics and types of functional materials. Crystal structure and Properties. Effect of size on properties, effect of interfaces on properties. Magnetic materials and storage applications.

UNIT-II

High Temperature Behaviour of Amorphous and Nanocrystalline Soft Magnetic Materials Magnetic storage devices store data using a combination of magnetic fields and binary data, Band structure, Semiconductor devices – Theory, examples and applications of Optically active materials.

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:

1. Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic applications; Deborah D L Chung, World Scientific Publishing, 2010.
2. Advanced Functional Materials (Advanced Material Series) by Ashutosh Tiwari, Lokman Uzun.

Reference Books:

1. Functional Materials 1st Edition, Preparation, Processing and Applications by S. Banerjee, A.K.Tyagi.
2. Advanced Functional Materials by Woo, Hee - Gweon, Li, Hong.
3. Functional Materials: Properties, Performance and Evaluation by Ewa Klodzinska.

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 back ground 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

Compaction**:** Theory of consolidation: Pressure transmission in powders. Compressibility and compactability of powders, Green strength, Hot and cold isostatic pressing, Powder rolling.
Sintering: Mechanisms of Sintering, Activated sintering, Liquid phase sintering, Factors affecting sintering, Sintering atmospheres, Properties of sintered parts.

UNIT–IV

Applications: Porous parts: Self-lubricating bearings, filters: Dispersion strengthened alloys by powder metallurgy route: Cu / Al_2O_3, Sintered Aluminum Powder. Electrical materials: Tungsten lamp filaments, electrical contacts, welding electrodes.

UNIT –V

Magnetic materials: Soft magnetic materials (Fe, Fe-Ni); Permanent magnets (Alnico, $SmCo_5$), Cemented carbides; Cermets.

Text Books:

1. Powder Metallurgy – A.K. Sinha.
2. Powder Metallurgy Technology - G S Upadhyaya.

Reference Books:

1. Introduction to Powder Metallurgy – J.S. Hirshhorn.
2. Powder Metallurgy Principles – F.V. Lenel.
3. Powder Metallurgy Practice and Applications – R.L. Sands & C.R. Shakespeare.
4. Powder Metallurgy by R.M German.
5. Powder Metallurgy by TC Angelo and R. Subramanyam.

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

L	T	P	C
3	0	0	3

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

Introduction to basic concepts of Materials Science, Salient properties of important material classes. Property requirement of biomaterials. Concept of biocompatibility. Structure and properties of biological cells & tissues. Cell-material interactions and foreign body response.

UNIT-II

Assessment of biocompatibility of biomaterials. In vitro biochemical assays (cellular adhesion, cellular viability using MTT, osteogenic differentiation using ALP assay; Biomnuneralisation using Osteocalcin assay). In vivo testing and histocompatibility assessment. Genotoxicity assessment (Physical damage to DNA by biomaterial eluates).

UNIT–III

Important bio-metallic alloys: Ti-based, stainless steels, Co-Cr-Mo alloys. Bio-inert, Bioactive and bioresorbable ceramics. Biocompatibility of Alumina & Carbon Nanotube Reinforced Hydroxyapatite. Glass -ceramics for dental restoration applications.

UNIT–IV

Processing and properties of different bio-ceramic materials with emphasize on hydroxyapatite. Synthesis of biocompatible coatings on structural implant materials. Plasma spraying of carbon nanotube reinforced hydroxyapatite on Ti-6Al-4V substrate, in-vitro cytocompatibility. Microstructure and properties of glass-ceramics. Biodegradable polymers.

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
2. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Reference Books:

1. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.
2. Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
3. Biological Performance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
4. Basic Cell Culture: A Practical Approach, Edited by J.M. Davis, IRL Press, Oxford University Press, New York, 1994.

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
3	0	0	3

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-strokes 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:

1. Transport phenomena, 2nd Edition: R. Byron Bird, Warren E. Stewart and Edwin N Lightfoot; John Wiley & Sons.
2. Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition: James R. Welty, Charles E. Wicks, Robert E. Wilson and Gregory Rorrer; John Wiley & Sons.

Reference Books:

1. Transport phenomena in materials processing : D.R. Poirier and G.H. Geiger, TMS.
2. Introduction to Fluid Mechanics, 5th Edition: Robert W. Fox & Alan T. McDonald: John Wiley & Sons.

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

L	T	P	C
0	0	0	8

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.