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

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

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

I YEAR II SEMESTER

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

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	MM302PC	Mineral Processing	3	0	0	3
3	MM303PC	Introduction to Transport Phenomenon	3	0	0	3
4	MM304PC	Physical Metallurgy	3	1	0	4
5	MM305PC	Materials Thermodynamics	3	0	0	3
6	MM306PC	Mineral Processing Lab	0	0	3	1.5
7	MM307PC	Metallography Lab	0	0	2	1
8	MM308PC	Materials Chemistry Lab	0	0	3	1.5
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	**18**	**2**	**8**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM401PC	Principles of Extractive Metallurgy	3	0	0	3

2	EE401ES	Basic Electrical and Electronics Engineering	3	1	0	4
3	MM403PC	Mechanical Metallurgy	3	0	0	3
4	MM404PC	Phase Transformations	3	0	0	3
5	MM405PC	Iron and Steel Making	4	0	0	4
6	EE409ES	Basic Electrical and Electronics Engineering Lab	0	0	2	1
7	MM407PC	Mechanical Metallurgy Lab	0	0	3	1.5
8	MM408PC	Phase Transformations Lab	0	0	3	1.5
9	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	**16**	**1**	**10**	**21**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM501PC	Non-Ferrous Extractive Metallurgy	3	1	0	4
2	MM502PC	Environmental Degradation of Materials	3	1	0	4
3	MM503PC	Mechanical Working of Metals	3	1	0	4
4	SM505MS	Engineering Economics and Accountancy	3	0	0	3
5		Professional Elective - I	3	0	0	3
6	MM504PC	Mechanical Working of metals Lab	0	0	3	1.5
7	MM505PC	Extractive Metallurgy Lab	0	0	3	1.5
8	MM506PC	Environmental Degradation of Materials Lab	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MM601PC	Materials Characterization	3	1	0	4
2	MM602PC	Non-Metallic Materials	3	1	0	4
3	MM603PC	Material Processing (Casting & Welding)	3	1	0	4
4		Professional Elective - II	3	0	0	3
5		Open Elective –I	3	0	0	3
6	MM604PC	Material Processing Lab (Casting & Welding experiments)	0	0	3	1.5
7	MM605PC	Modeling and Simulations Lab for Metallurgical and Materials Engineering	0	0	3	1.5
8	EN608HS	Advanced Communication Skills Lab	0	0	2	1
9	*MC609	Environmental Science	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

***MC609 - Environmental Science – Should be Registered by Lateral Entry Students Only.**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MM701PC	Introduction to Instrumentation	3	0	0	3
2		Professional Elective - III	3	0	0	3
3		Professional Elective - IV	3	0	0	3
4		Open Elective - II	3	0	0	3
5	SM701MS	Fundamentals of Management for Engineers	3	0	0	3

6	MM702PC	Seminar	0	0	2	1
7	MM703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
8	MM704PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**8**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective - III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	MM801PC	Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***MC – Satisfactory/Unsatisfactory**

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

Professional Elective – I

MM511PE	Powder Metallurgy
MM512PE	Nuclear Materials
MM513PE	Fatigue and Fracture Mechanics

Professional Elective – II

MM611PE	Nano Materials
MM612PE	Electronic Materials
MM613PE	Furnace Technology and Pyrometry

Professional Elective – III

MM711PE	Alternate Routes of Iron & Steel Making
MM712PE	Bio Materials
MM713PE	Non-Destructive Testing

Professional Elective – IV

MM721PE	Functional Materials
MM722PE	Computational Materials Engineering
MM723PE	Ceramics Science and Technology

Professional Elective – V

MM811PE	Advanced Manufacturing Technologies
MM812PE	Design and Selection of Engineering Materials
MM813PE	Composite Materials

Professional Elective – VI

MM821PE	Failure Analysis
MM822PE	Energy Materials
MM823PE	Super Alloys

MA101BS: MATHEMATICS - I

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Course Objectives: To learn

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

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

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

UNIT-I: Matrices

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors

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

UNIT-III: Sequences & Series

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

UNIT-IV: Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series.

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

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

Definitions of Limit and continuity.

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

PH102BS: ENGINEERING PHYSICS

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Course Objectives:

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

Course outcomes: Upon graduation, the graduates will have:

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

UNIT-I: Introduction to Mechanics

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

UNIT-II: Harmonic Oscillations

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

UNIT-III: Waves in one dimension

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

UNIT-IV: Wave Optics

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

UNIT-V: Lasers and Fibre Optics

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CS103ES/CS203ES: PROGRAMMING FOR PROBLEM SOLVING

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Course Objectives:

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

Course Outcomes: The student will learn

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

UNIT - I: Introduction to Programming

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems
Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming
Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments
Bitwise operations: Bitwise AND, OR, XOR and NOT operators
Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops
I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr. Command line arguments

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

Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays
Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings
Structures: Defining structures, initializing structures, unions, Array of structures
Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation)
Enumeration data type

UNIT - III: Preprocessor and File handling in C:

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef
Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Function and Dynamic Memory Allocation:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries
Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions
Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: Introduction to Algorithms:
Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.
Basic searching in an array of elements (linear and binary search techniques),
Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms),
Basic concept of order of complexity through the example programs

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ME104ES/ME204ES: ENGINEERING GRAPHICS

B.Tech. I Year I Sem.

L	T	P	C
1	0	4	3

Pre-requisites: Nil

Course objectives:

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

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

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

UNIT – I

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

UNIT- II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

PH105BS: ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	3	1.5

List of Experiments:

1. Melde's experiment:
   To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

2. Torsional pendulum:
   To determine the rigidity modulus of the material of the given wire using torsional pendulum.

3. Newton's rings:
   To determine the radius of curvature of the lens by forming Newton's rings.

4. Diffraction grating:
   To determine the number of lines per inch of the grating.

5. Dispersive power:
   To determine the dispersive power of prism by using spectrometer.

6. Coupled Oscillator:
   To determine the spring constant by single coupled oscillator.

7. LCR Circuit:
   To determine quality factor and resonant frequency of LCR circuit.

8. LASER:
   To study the characteristics of LASER sources.

9. Optical fibre:
   To determine the bending losses of Optical fibres.

10. Optical fibre:
    To determine the Numerical aperture of a given fibre.

Note: Any 8 experiments are to be performed

CS106ES/CS206ES: PROGRAMMING FOR PROBLEM SOLVING LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	3	1.5

[Note:The programs may be executed using any available Open Source/ Freely available IDE
Some of the Tools available are:
CodeLite: https://codelite.org/
Code::Blocks: http://www.codeblocks.org/
DevCpp : http://www.bloodshed.net/devcpp.html
Eclipse: http://www.eclipse.org
This list is not exhaustive and is NOT in any order of preference]

Course Objectives: The students will learn the following:

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

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

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

Practice sessions:

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

Simple numeric problems:

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

Expression Evaluation:

a. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
b. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
c. Write a program that finds if a given number is a prime number
d. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
e. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
f. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
g. Write a C program to find the roots of a Quadratic equation.
h. Write a C program to calculate the following, where x is a fractional value.
i. 1-x/2 +x^2/4-x^3/6
j. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+…….+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Arrays and Pointers and Functions:

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

Files:

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

e. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).

Strings:

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

Miscellaneous:

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

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

Sorting and Searching:

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

Suggested Reference Books for solving the problems:

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

***MC109ES: ENVIRONMENTAL SCIENCE**

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	0

Course Objectives:

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

Course Outcomes:

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

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

UNIT-V

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHI Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

MA201BS: MATHEMATICS - II

B.Tech. I Year II Sem.

L	T	P	C
3	1	0	4

Course Objectives: To learn

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

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

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

UNIT-I: First Order ODE

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

UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Multivariable Calculus (Integration)

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

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

UNIT-IV: Vector Differentiation

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

UNIT-V: Vector Integration

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CH102BS/CH202BS: CHEMISTRY

B.Tech. I Year II Sem.

L	T	P	C
3	1	0	4

Course Objectives:

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

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

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

UNIT - I:

Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. π molecular orbitals of butadiene and benzene.

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

UNIT - II:

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

UNIT - III:

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

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

UNIT - IV:

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

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

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

UNIT - V:

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

TEXT BOOKS:

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

ME203ES: ENGINEERING MECHANICS

B.Tech. I Year II Sem.

L	T	P	C
3	1	0	4

Course Objectives: The objectives of this course are to

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

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

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

UNIT-I:

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

UNIT-II:

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

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

UNIT-III:

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

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

UNIT-IV:

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

UNIT-V:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ME105ES/ME205ES: ENGINEERING WORKSHOP

B.Tech. I Year II Sem.

L	T	P	C
1	0	3	2.5

Pre-requisites: Practical skill

Course Objectives:

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

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

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

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

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

2. TRADES FOR DEMONSTRATION & EXPOSURE:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

EN105HS/EN205HS: ENGLISH

B.Tech. I Year II Sem. **L T P C**
2 0 0 2

INTRODUCTION

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

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

Learning Objectives: The course will help to

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

Course Outcomes: Students should be able to

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

UNIT –I

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

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

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

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

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

UNIT –II

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

Vocabulary: Synonyms and Antonyms.

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

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

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

UNIT –III

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

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

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

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places and Events – **Classifying**- Providing Examples or Evidence

UNIT –IV

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

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension**-** Intensive Reading and Extensive Reading

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

UNIT –V

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

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

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

CH106BS/CH206BS: ENGINEERING CHEMISTRY LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	3	1.5

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

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

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

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

List of Experiments:

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

REFERENCE BOOKS:

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

EN107HS/EN207HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

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

Learning Outcomes: Students will be able to attain

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

Syllabus

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

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

Listening Skills

Objectives

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

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

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

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions

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

- **The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab)**

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III
CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

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

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Interview Skills.
Practice: Mock Interviews.

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Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**

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

System Requirement (Hardware component):

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

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. **Interactive Communication Skills (ICS) Lab:**

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. II Year I Sem. **L T P C**
3 1 0 4

Pre-requisites: Mathematical Knowledge at pre-university level

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

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

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

Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

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

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution
Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

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

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region.
Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

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

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

UNIT - V: Complex Variables (Integration) **10 L**

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

TEXT BOOKS:

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

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

REFERENCES:

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

MM302PC: MINERAL PROCESSING

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

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

Course Outcomes: At the end of the course the student will be able to:
- Understand the importance of mineral processing technology.
- Understand techniques of mineral processing for concentration of ore minerals economically.
- Review environment friendly techniques for concentration of sulphide minerals.
- Compute the recovery of ore mineral after concentration.

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

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

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

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

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

TEXT BOOKS:
1. Mineral processing technology - B. A. Wills
2. Principles of Mineral Dressing - A.M. Gaudin

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

MM303PC: INTRODUCTION TO TRANSPORT PHENOMENON

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

Course objectives:
This course will introduce the concepts of fluid flow, heat transfer and mass transfer with behavior and processing of engineering materials as the focus.

Course outcomes: At the end of this course, the student should be able to
- Pose a problem in transport phenomena as a balance equation
- Make suitable assumptions to make the problem a well defined one
- Identify suitable geometry and boundary conditions for the problem
- Solve simple partial differential equations relevant to transport phenomena
- Plot different parameters and interpret the solutions

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.

MM304PC: PHYSICAL METALLURGY

B.Tech. II Year I Sem.

L	T	P	C
3	1	0	4

Course objectives:

- To learn about the principles of alloy design, phase diagram and strengthening mechanisms in different metals and alloys.
- To study the fundamental aspects of heat treatment and its influence on properties and applications
- To obtain knowledge about the physical metallurgy of specific and important engineering materials such as ferrous and non-ferrous alloys

Course Outcomes: By completing this course the student will have:

- The ability to identify the concepts of alloy design, phase diagrams and strengthening mechanisms and apply them to materials systems
- The knowledge of heat treatment and the resulting microstructure in materials
- The knowledge of physical metallurgical aspects of important engineering alloys

UNIT - I

Phase diagrams: binary and ternary, principles of alloying, Hume-Rothery rules. Strengthening mechanisms, solid solution, work hardening, precipitation hardening, dispersion strengthening.

UNIT - II

Iron carbon diagram, isothermal, and continuous cooling transformation diagrams; influence of alloying elements on transformation characteristics.

UNIT - III

Heat treatment - annealing, normalizing, hardening and tempering of steels, hardenability

UNIT - IV

Introduction to important ferrous alloys, stainless steels, special steels, cast irons, aluminium alloys.

UNIT - V

Titanium alloys, copper base alloys. Superalloys, shape memory alloys – classification, heat treatment, properties and applications.

TEXT BOOKS:

1. Physical Metallurgy: Principles and Practice, V. Raghavan, PHI Learning, Delhi, 2008.
2. Physical Metallurgy Principles, R. Abbaschian, R. E. Reed-Hill, Cengage Learning, 2009

REFERENCE BOOKS:

1. Physical Metallurgy Vols. I, II, III, R.W. Cahn and P. Haasen, North Holland, 1996.
2. Light Metals, I.J. Polmear, Elsevier, 2005

MM305PC: MATERIALS THERMODYNAMICS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To highlight the fundamental role of Thermodynamics in describing metallurgical and materials processes.
- To learn and use thermodynamic functions, rules and relations and interpret thermodynamic plots and diagrams.

Course Outcomes: After completing this course, the student should be able to:

- Use the various thermodynamic functions appropriately under different experimental situations involving gases, liquids and solids
- Derive and explain the Gibbs Phase rule
- Utilize Ellingham diagrams Utilize Pourbaix diagrams

UNIT - I

Objectives and Limitations of Thermodynamics, concepts of system and state, heterogeneous and homogeneous systems, gases: Ideal gas, Real gas, Van-der Waals; extensive and intensive properties, of system, thermodynamic variables, thermodynamic equilibrium. Reversible and irreversible processes. First Law of Thermodynamics: Nature of first law, relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, enthalpy change with temperature, Kirchhoff's equation.

UNIT - II

Second Law of Thermodynamics: Efficiency of a cyclic process, Carnot cycle, Carnot theorem, second law of thermodynamics, concept of entropy, entropy and quantification of irreversibility, reversible processes. Third law of thermodynamics: Background of third law, deductions from third law, applications of third law, and other methods of obtaining $\Delta S0$ for a reaction. Statistical interpretation of entropy, Boltzmann equation.

UNI - III

Energy Functions: Purposes of the new functions, definition of Helmholtz and Gibbs energy change, meaning of thermodynamically possible process, determination of ΔG from thermal data useful relationships among thermodynamic functions, Maxwell's equations and Gibbs-Helmholtz equation. Fugacity, activity and equilibrium constant: Concepts of fugacity, activity and equilibrium constant variation of the equilibrium constant with temperature. Application of the Clausius – Clapeyron equation for single substance, Duhringes rule for the estimation of the vapor pressures of an element, Integration of Clausius – Clapeyron equation.

UNIT - IV

Solutions: Composition, Concept of chemical potentia, partial molal quantities, Gibb's - Duhem equation, integration of Gibbs' - Duhem equation, ideal dilute solutions, ideal solutions, Raoults Law, actual (Non-ideal) solutions (Henry's Law), Sieverts law, Excess thermodynamics quantities.

UNIT - V

Application of Ellingham diagrams to process metallurgy: Introduction, calculation of equilibrium constants from standard energy changes, general description of Ellingham diagrams, Interpretation of two or more free energy change vs. temperature lines taken together, derivation and uses of the oxygen, nomographic scale in Richardson's diagrams.

TEXT BOOKS:

1. Introduction to Thermodynamics of Materials, 5th Edition, David R Gaskell, Taylor and Francis, 2016.
2. Materials Thermodynamics with Emphasis on Chemical Approach, Hae-Geon Lee, World Scientific Publishing, 2012.

REFERENCE BOOKS:

1. Thermodynamics in Materials Science, Robert De-Hoff, CRC Press, 2006.
2. Principles of Metallurgical Thermodynamics/ SK Bose and SK Roy; Editor-in- Chief, Baldev Raj. Published by Universities Press (India) Private Limited, 2014.

MM306PC: MINERAL PROCESSING LAB

II B.Tech. (MME) I -Sem.

L	T	P	C
0	0	3	1.5

Course objectives:
This laboratory course is designed to make the student to understand and demonstrate the process variables in mineral processing techniques employed. The mineral characteristics like size and size distribution etc. also evaluated.

Course outcomes: The student would gain hands on experience on

- Particle size and its distribution in a given material.
- Determination of reduction ration in crushing and grinding machines.
- To have an understanding on magnetic separation of magnetic ores from non magnetic.
- To understand about different ore characteristics and various industrial mineral processing operations for beneficiation.

List of experiments:

1. Sampling of an ore from the bulk by i) Coning and quartering method ii) Riffle sampler methods
2. Sizing of material by Sieve analysis.
3. Verification of Stoke's Law.
4. Determining the reduction ratio of a jaw crusher.
5. To determine the variation of reduction ratio with process variables in Rolls crusher.
6. Effect of process variables on reduction ratio and particle size distribution in ball mill.
7. To find the grindability index of coal.
8. Verification of Laws of Communition.
9. Determination of the efficiency of a magnetic separator.
10. Determination of the efficiency of a jig.
11. Particle separation by fluid flow using Wilfley table.
12. Concentration of metallic and non-metallic ores by Froth-Flotation process

List of equipment:

1. Riffle Sampler, ,2. Sieve Shaker with Sieves 3. Stokes' Apparatus, 4. Jaw Crusher, 5. Roll Crusher, 6. Ball Mill, 7. Grindability Index Apparatus, 8. Magnetic Separator, 9. Jig, 10. Wilfly's Table, 11. Froth – Floatation Equipment, 12. Balances

MM307PC: METALLOGRAPHY LAB

II B.Tech. (MME) I Sem.

L	T	P	C
0	0	2	1

Course objectives:
To provide hands on experience to prepare the samples for metallographic analysis and understand the basic constituents of microstructures.

Course Outcomes: By completing this laboratory course, students will:

- Get to know and gain hands on experience with various techniques of sample preparation for metallographic analysis of metals and alloys
- Be able to analyse the hardness of different constituents of microstructure using different hardness testers
- Obtain knowledge of quantitative analysis, such as grain size, volume fraction of second phases.

List of experiments:

1. Study of metallurgical microscope
2. Metallographic preparation of metals and alloys
3. Microscopic examination and microstructure interpretation of steels
4. Microscopic examination and microstructure interpretation of nonferrous metals
5. Microscopic examination and microstructure interpretation of heat treated steels
6. Microscopic examination and microstructure interpretation of cast structures
7. Microscopic examination and microstructure interpretation of wrought structures
8. Microscopic examination and microstructure interpretation of welded structures
9. Microscopic examination of defects and failures in components
10. Conduct of Hardness testing of metals on Vickers scale

List of equipment:

1. Metallurgical microscopes, 2. Belt grinders, 3. Disc polishers, 4 Vickers Hardness tester
5. Metallographic Samples (Ferrous and Non-Ferrous)

TEXT Books:

1. R. Haynes, 1984, Springer science + Business Media, New York
2. Douglas B. Murphy, 2001, Wiley-Liss, Inc. USA

MM308PC: MATERIALS CHEMISTRY LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	3	1.5

Course objectives:
This course introduces chemical analysis of metallic alloys using laboratory practice.

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

- Identify the major elements in a metallic alloy using chemical methods
- Quantify specific elements in ferrous and non-ferrous alloys using titration
- Interpret the results from different spectroscopy instruments to determine chemical composition

List of experiments:

1. Identification of metallic and non-metallic ions in the given substance by wet chemical methods.
2. Estimation of Iron in Iron ore by $KMnO_4$ and $K_2Cr_2O_7$ methods.
3. Estimation of Silicon in Cast Iron by chemical method.
4. Estimation of Manganese in Ferro-alloys by spectrophotometer.
5. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
6. Estimation of Copper in Brass by Electrochemical Analyzer.
7. Estimation of concentration of $KMnO_4$ in the solution using colorimeter.
8. Determination of viscosity of a given fluid by Viscometers (Redwood -I, Redwood – II and Saybolt viscometer).
9. Determination of calorific value of Solid and liquid fuels.

List of Equipment:

1. Flame Photometer, 2. Spectrophotometer. 3. Electrochemical Analyzer. 4. Colorimeters.
5. Chemicals and Glassware. 6. Redwood and Saybolt viscometers. 7 Junker's gas calorimeter,
8. Bomb Calorimeter

TEXT BOOKS:

1. A text book of metallurgical analysis, B C Aggarwal, Khanna Publishers (2002)
2. Corrosion Engineering, Mars Fontana, McGraw Hill (2017)

REFERENCE BOOKS:

1. Instrumental methods of analysis, Willard, CBS Publishers & Distributors (2004)
2. Transport phenomena, B. Bird, W.E. Stewart and E.N. Lightfoot, John Wiley & Sons (2007)

***MC309/*MC409: CONSTITUTION OF INDIA**

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	0

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

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

Course content

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

MM401PC: PRINCIPLES OF EXTRACTIVE METALLURGY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To learn and emphasize the Principles of Pyrometallurgy, hydrometallurgy and electrometallurgy.
- To learn scientific concepts of extraction and refining
- Obtain knowledge of equipment used in Pyrometallurgy, hydrometallurgy and electrometallurgy

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

- List out ore minerals for ferrous and non-ferrous metals.
- Discuss the principles of fire refining, liquation, distillation refining and zone refining.
- Examine the importance of slag chemistry in the extraction process.
- Recognize the importance of Ellingham diagrams and criteria required for reduction of metals.

UNIT - I

Introduction: Classification of ores. Basics of Pyrometallurgy, Calcination, Roasting and types of roasting.

UNIT - II

Sintering pelletisation and Smelting: Basic Principles with examples. Slags: Classification, properties and uses.

UNIT - III

Hydrometallurgy: Advantages and disadvantages. Flowchart. Principles and types of leaching. Solution purification by ion and solvent exchange. cementation.

UNIT - IV

Principles of electrometallurgy: Electro winning and Electro refining with typical examples.

UNIT - V

Fire refining, Distillation, liquation, 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-Gosh

REFERENCE BOOK:

1. A text book of Metallurgy-A.R. Bailey.

EE401ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. II Year II Sem.

L	T	P	C
3	1	0	4

Course Objectives:

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

Course Outcomes:

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

UNIT - I:

D.C. CIRCUITS

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

A.C. CIRCUITS

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

UNIT - II:

ELECTRICAL INSTALLATIONS

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

UNIT - III:

ELECTRICAL MACHINES

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

UNIT - IV:

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

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

UNIT - V:

BIPOLAR JUNCTION TRANSISTOR (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

FIELD EFFECT TRANSISTOR (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MM403PC: MECHANICAL METALLURGY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To obtain knowledge of stress response of materials, load bearing ability, elastic and plastic deformation.
- To obtain insight about different mechanical properties of materials under engineering applications.

Course outcomes: After completing this course, students will be able:

- To explain how elastic and plastic deformations as events taking place at atomic and crystal levels
- To understand the concept of plastic deformation and the role of dislocations in plastic deformation of materials
- To explain the mechanisms of fatigue and creep failures in materials
- To discuss strengthening mechanisms in metals as well as failure analysis methods
- To understand the load bearing ability of different materials and their response to stress under engineering applications.

UNIT - I

Plastic Deformation in Metals and Alloys: Critical resolved shear stress. Defects in crystalline materials Point defects and line defects. The concept of dislocation - Edge dislocation and screw dislocation. Interaction between dislocations, sessile dislocation, glissile dislocation, dislocation climb, Jogs, Forces on dislocations Energy of a dislocation. Frank Reed source, slip and twinning.

UNIT - II

Fracture: Elementary theories of fracture, Griffith's theory of brittle fracture, Ductile Fracture, Notch sensitivity. Hardness Test: Methods of hardness testing Brinells, Vickers, Rockwell, Rockwell superficial, Shore and Poldi methods, Microhardness test, relationship between hardness and other mechanical properties.

UNIT - III

Tension Test: Engineering stress and Engineering strain, True stress-strain curve. Tension Test and tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties. Compression Test, Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, significance of transition temperature curve, Metallurgical factors affecting the transition temperature, temper embrittlement. DBTT curve and its importance. Fracture toughness testing - COD and CTOD tests.

UNIT - IV

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. Effect of metallurgical variables on fatigue. Low cycle fatigue - High cycle 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 by George E Dieter, McGraw-Hill Education; 3 edition June 1986
2. Mechanical Behaviour of Materials, Thomas H Courtney, McGraw-Hill Education; 2nd revised edition

REFERENCE BOOKS:

1. Mechanical Behaviour of Materials, Marc Andre Meyers and Krishnan Kumar Chawla, Cambridge University Press, 2nd edition
2. Mechanical Metallurgy - White & Le May

MM404PC: PHASE TRANSFORMATIONS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:
To introduce the student to key concepts in Phase transformations and enable an understanding of the steps involved in several important phase transformations.

Course outcomes: After completing this course, the student should be able to:
- Classify phase transformations
- Indicate important steps in different types of phase transformations
- Explain phase transformations from the perspective of thermodynamics and kinetics
- Describe a few well known and studied phase transformations

UNIT - I
Definition and types of Phase transformations, Diffusion: Fick's laws of diffusion, solution of Fick's second law and its applications, atomic model of diffusion and role of crystal defects, temperature dependence of diffusion coefficient.

UNIT – II
Kirkendall effect. Diffusional transformation in solids and diffusionless transformation in solids. Nucleation and growth, energy considerations; homogeneous nucleation, heterogeneous nucleation, growth kinetics, overall transformation rates.

UNIT - III
Crystal interfaces and microstructure. Microstructure evolution, including recrystallization and grain growth. Precipitation from solid solution: Homogeneous and hetrogeneous nucleation of precipitates, the aging curve, mechanisms of age hardening, examples from Al-Cu and other alloy systems.

UNIT - IV
Martensitic Transformations: General characteristics of martensitic reactions, similarity to deformation twinning, bain distortion, crystallography and kinetics of martensitic transformations, examples from ferrous and non-ferrous alloy systems.

UNIT - V
Order-disorder Transformation Examples of ordered structures, long and short range order, detection of super lattices, influence of ordering on properties. Spinodal decomposition.

TEXT BOOKS:
1. Solid State Phase Transformations, V. Raghavan, Prentice Hall India Learning Private Limited, 1987.
2. Phase Transformations in Metals and Alloys, David A. Porter and Kenneth E. Easterling, Third Edition, CRC Press, 2017

REFERENCE BOOKS:
1. Physical Metallurgy Principles, Reza Abbaschian, Lara Abbaschian, and Robert E. Reed- Hill, Cengage, 2013
2. Mechanisms of Diffusional Phase Transformations in Metals and Alloys, Hubert I. Aaronson, Masato Enomoto, and Jong K. Lee, CRC Press, 2016.

MM405PC: IRON AND STEEL MAKING

B.Tech. II Year II Sem.

L	T	P	C
4	0	0	4

Course objectives:

- To provide the knowledge of Iron making by Blast Furnace, Physio- chemical principles involved in iron making.
- To understand and demonstrate the various types of steel making processes, Hot metal route and scrap route.

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

- Describe the physical and chemical processes that take place during iron making and steelmaking
- Analyses the effect of change in process parameters in iron making and steelmaking processes
- Describe the methods for control of quality in iron and steel production

UNIT - I

Principles of Iron making, Raw materials for Iron making, Preparation of iron ores; Agglomeration of Iron ore fines: Sintering and Pelletisation, Principles, Factors affecting sintering, sintering bonds; Theory of Pelletisation, Water-particles system. 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, burden distribution. 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 Slags and its properties. 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. Extractive Metallurgy 2: Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,)
2. Extractive Metallurgy 3: Processing Operations and Routes, Alain Vignes (ISTE Ltd.,)
3. An introduction to modern steel making, R. H. Tupkary, Khanna Publishers (2000)
4. An introduction to modern iron making, R. H. Tupkary, Khanna Publishers (2004)

EE409ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:

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

Course Outcomes:

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

List of experiments/demonstrations:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
   (ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.

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

MM407PC: MECHANICAL METALLURGY LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	1.5

Course objectives:
To obtain knowledge on various mechanical testing machines, and mechanical testing methodology.

Course Outcomes: After completing the course, the student will be able
- To extract and interpret sensible information from mechanical test data.
- To give explanation on relationships between metallurgy of the metals and their mechanical properties.
- To perform mechanical testing of metals (Hardness, tension and Impact)
- To select metals for engineering applications.
- To design metals for engineering applications.

List of experiments:
1. To determine the Brinell Hardness of ferrous and non-ferrous samples.
2. To determine the Rockwell hardness of ferrous and non-ferrous samples.
3. To determine the hardness of ferrous and non-ferrous samples by using Vickers hardness tester.
4. To Determination of hardness profile across weldments
5. To determine the elastic modulus, ultimate tensile strength, breaking stress, percentage
6. elongation percentage reduction in area of the given specimen by tensile test.
7. To plot True stress Vs True stain and compare with engineering stress strain curve by tensile test.
8. To determine the modulus of rigidity of given material by torsion test
9. To determine the Charpy and Izod (V & U Groove notch) impact strength of a given material at room temperature.
10. To determine the fatigue strength of given material at a given stress

List of equipment:
1. Brinell Hardness Machine 2. Vickers Hardness Machine 3. Rockwell Hardness Machine 4. UTM,
5. Torsion Testing Machine 6. Impact Testing Machine 7. Fatigue Testing Machine

TEXT BOOKS:
1. Appropriate ASTM standards to be followed to understand associated theory.
2. Mechanical Metallurgy by George E Dieter, McGraw-Hill Education; 3rd edition June 1986

MM408PC: PHASE TRANSFORMATIONS LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	1.5

Course Objective:
This Laboratory course is designed to make the student understand and demonstrate the various types of heat treatment processes, process variables and surface hardening treatments for ferrous and non-ferrous metals and alloys.

Course outcomes: The student would gain hands on experience

- To define heat treatment cycles for ferrous and non-ferrous metals and alloys with proper
- understanding of different heat treatment process variables.
- To evaluate the microstructure and hardness after successful heat treatment.

List of Experiments:
1. Annealing of plain carbon steel and observation of hardness and microstructure
2. Normalizing of plain carbon steel and observation of hardness and microstructure
3. Hardening of plain carbon steel and observation of hardness and microstructure
4. Study of tempering characteristics of hardened steel.
5. Study of age hardening phenomenon in an Al-Cu alloy or Cu-Be alloy
6. Spheroidizing of high carbon steel
7. Determination of hardenability of a steel using Jominy End Quench Test
8. Re-crystallization studies on cold worked Cu or Cu alloys

Equipment:
1. Muffle Furnaces 1200 ^{0}C, 2. Jominy End Quench Apparatus, 3. Microscopes,
4. Rockwell Hardness Tester

***MC409/*MC309: GENDER SENSITIZATION LAB**

(An Activity-based Course)

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	0

COURSE DESCRIPTION

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

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

Objectives of the Course:

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

Learning Outcomes:

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

UNIT - I: UNDERSTANDING GENDER

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

UNIT – II: GENDER ROLES AND RELATIONS

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

UNIT – III: GENDER AND LABOUR

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

UNIT – IV: GENDER - BASED VIOLENCE

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

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

UNIT – V: GENDER AND CULTURE

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

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

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

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

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

ASSESSMENT AND GRADING:

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

MM501PC: NON-FERROUS EXTRACTIVE METALLURGY

B.Tech. III Year I Sem.

L	T	P	C
3	1	0	4

Course objectives:

- To explain the various methods of extraction of nonferrous metals.
- To describe the procedure and equipment used for production of nonferrous metals from their ores.

Course outcomes: At the end of the course, student would be able to recommend

- The course gives an insight into the various methods of production of important nonferrous metals
- The students get an idea of energy saving methods and environment controlling methods in extractive units.
- The course is useful for higher studies, R&D, and also for getting jobs in metallurgical processing industries.

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 Handspring processes. Titanium: Upgrading of ilmenite, chlorination of titanium, 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. Non-Ferrous Extractive Metallurgy – G B Gill John Wiley & Sons 1980

REFERENCE BOOKS:

1. Extractive Metallurgy 1: Basic Thermodynamics and Kinetics, Alain Vignes (ISTE Ltd.,)
2. Extractive Metallurgy 2: Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,)
3. Extractive Metallurgy 3: Processing Operations and Routes, Alain Vignes (ISTE Ltd.)
4. Topics in non-ferrous extractive metallurgy, Burkin, Wiley-Blackwell (1980)

MM502PC: ENVIRONMENTAL DEGRADATION OF MATERIALS

B.Tech. III Year I Sem.

L	T	P	C
3	1	0	4

Course objectives: To familiarize the student with the extent and importance of material degradation. To study various aspects of corrosion and its control.

Course outcomes: After completing this course, the student should be able to:

- Explain the importance of studying corrosion
- Describe the thermodynamic aspects of corrosion
- Describe the kinetic aspects of corrosion
- Indicate the various forms of corrosion
- Explain the measurement and control of corrosion.

UNIT - I

Introduction, Definition, Fundamentals of electrochemistry principles, Forms of environmental degradation, Classification of corrosion, Importance of corrosion studies and cost of corrosion. Corrosion principles, Electrochemical aspects, Thermodynamic aspects of corrosion – Gibbs energy and electrochemical potential

UNIT - II

Metal-Electrolyte Interface, EMF series, Nernst relationship and Pourbaix Diagram, Kinetic aspects of corrosion: Corrosion rate, Current density, Exchange current density, Mixed potential theory, Polarization and Passivation.

UNIT - III

Forms of corrosion: Uniform Corrosion, Localized Corrosion; Pitting; Crevice Corrosion, Galvanic Corrosion and Protection; Concentration Cells, Intergranular Corrosion; De-alloying, Environmentally assisted failures (SCC, Hydrogen embrittlement; corrosion fatigue, Erosion; Fretting. Experimental methods to identify corrosion susceptibility

UNIT - IV

Corrosion Measurements and Corrosion Control: Exposure studies, Electrochemical work bench, DC and AC methods of testing, Polarization measurements- Corrosion rate assessment by Tafel's extrapolation method, Linear polarization resistance (LPR). Coatings, Inhibitors, Cathodic and Anodic protection.

UNIT - V

Degradation of polymeric and composite materials and its prevention

TEXT BOOKS:

1. Corrosion Engineering, Mars. G. Fontana, McGraw Hill Education, 2017
2. Electrochemical Techniques in Corrosion Science and Engineering. R.G. Kelly, J.R. Scully, D.W. Shoesmith, R.G. Buchheit, CRC Press., 2002

REFERENCE BOOKS:

1. Corrosion: Metal / Environment Reactions, Volume 1, L.L. Shreir, R.A. Jarman, G.T. Burstein, Butterworth-Heinemann, 1994.
2. Principles and Prevention of Corrosion, Denny A. Jones, Pearson, 1995.

MM503PC: MECHANICAL WORKING OF METALS

B.Tech. III Year I Sem.

L	T	P	C
3	1	0	4

Course objectives: This course is mainly designed to provide knowledge about various metal forming operations, their process parameters, and mathematical equations associated with the process.

Course outcomes: After completing the course, the student will be able

1. To choose the best forming process for a specific product.
2. Use the Mohr's circle to graphically analyze stresses and strains;
3. Analyze, compare and finally gain theoretical experience for the advantages and limitations of different manufacturing processes
4. To practically appreciate the utilization of these fundamentals in industrial manufacturing processes.
5. To analyze metallurgical and mechanical aspects of forming of metals into useful shapes and properties.

UNIT - I

Stress and Strain Relationship for Elastic Behavior: Description of stress at a point. State of stress in two dimensions. Mohrs circle of stress in two dimensions, state of stress in three dimensions. Mohrs circle of stress in three dimensions. Description of strain at point.

UNIT - II

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 - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

1. Mechanical Metallurgy by GE Dieter (3rd edition)
2. Technology of Metal forming Processes – Surendra Kumar PHI 2008
3. Metal Forming: Mechanics and Metallurgy by William F. Hosford and Robert M. Caddel (4th edition), Cambridge University Press

REFERENCE BOOKS:

1. Mechanical working of metals-Avitzur.
2. Engineering Metallurgy-PartII-Higgins.
3. Mechanical Metallurgy- White and Lemay.

SM505MS: ENGINEERING ECONOMICS AND ACCOUNTANCY

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: 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.

Course Outcome: 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.

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: Cash Flows and Capital Budgeting: Significance of Capital Budgeting - 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 - IV: Borrowings on Investment: Equity Vs Debt Financing - Leverages- Concept of Leverage- Types of Leverages: Operating Leverage- Financial Leverage and Composite Leverage. (Simple Problems)

UNIT - V: Introduction to Accounting: Accounting Principles- procedure- Double entry system - Journal-ledger- Trial balance- Trading and Profit and Loss account- Balance Sheet. Cost Accounting, Introduction- Classification of costs- Breakeven Analysis, Meaning and its application, Limitations. (Simple Problems).

TEXT BOOKS:

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.
6. Zahid A Khan, Arshad N Siddique, et. al, Principles of Engineering Economics with Applications, 2e, Cambridge University Press.

MM511PE: POWDER METALLURGY (Professional Elective - I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course objectives: This course introduces the particulate technology to create components from powder route.

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

- List different stages of manufacturing using the powder metallurgy route
- Describe characteristics of a P/M component
- Describe the consolidation process during P/M route and identify the defects that arise
- Analyse the material and design needs of a P/M component

UNIT - I

Introduction. Importance of powder metallurgy. Comparison of powder metallurgy with other manufacturing techniques. Its scope and limitations. Methods of Powder Production: chemical reduction (tungsten, iron), carbonyl decomposition (iron, nickel), atomization (pure metal and multi component alloy powders), milling (oxides), electrolysis (elemental powders).

UNIT - II

Characterization of Powders: Importance. Determining powder characteristics: particle shape, size and size distribution, specific surface area, apparent and tap density, angle of repose, green strength. compressibility / compactability, powder conditioning.

UNIT - III

Consolidation of Metal Powders I - Compaction: Theory of consolidation; Pressureless powder shaping, pressure transmission in powders. Pressure dependence of densification. Die compaction and Isostatic pressing.

UNIT - IV

Consolidation of Metal Powders II- Sintering. Mechanisms of solid state and liquid phase sintering. Factors affecting sintering. Properties of sintered parts. Hot isostatic pressing. Sinter forging. Defects in P/M route and their control, Treatment of powder metallurgy components.

UNIT - V

Testing and quality control, metallic and ceramic P/M components; Applications of P/M products: Porous parts, self-lubricating bearings, dispersion strengthened materials, cermets, electrical materials, magnetic materials.

TEXT BOOKS:

1. Powder Metallurgy: science, technology and materials – Anish Upadhyaya, G.S. Upadhyaya, Universities Press (2011)
2. Power Metallurgy: science, technology and materials – P.C. Angelo, R. Subramanian, Prentice Hall India Learning Pvt. Ltd., (2008)

REFERENCE BOOKS:

1. Volume 7: Powder Metallurgy, ASM Handbook – P.K. Samal and J. W. Newkird, ASM (2015)
2. Powder Metallurgy Science – R.M. German, Metal Powder Industry (1994)

MM512PE: NUCLEAR MATERIALS (Professional Elective - I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: The objective of this course is to make understand the concepts of Nuclear Science and Special Properties required for materials to meet nuclear reactor requirements.

Course outcomes: By the end of the course student will get good knowledge on

- Fundamentals of nuclear chemistry and Physics
- Functional requirements of various reactor components and suitable materials
- Extraction of nuclear grade materials applicable in nuclear reactors
- Application of principles of physical metallurgy in understanding the changes takes place in materials after irradiation

UNIT - I

Elementary Nuclear Physics and Chemistry; Structure of nucleus, radioactivity, binding energy; nuclear interaction; fission and fusion; nuclear reaction; energy release and chain reactions; neutron absorption cross-section; multiplication and criticality concepts and factors.

UNIT - II

Reactor components; Types of reactors; PWR, BWR, Graphite Moderator Reactor, Heavy water Reactor, Graphite moderator Reactor, Light Water moderator Reactor, Liquid metal coolant reactor. Mechanisms of moderation, radiation detection, radiation effects on fissile and non-fissile materials; radiation damage and radiation growth; thermal cycling; protection against radiations.

UNIT - III

Materials for nuclear reactors; Considerations in selection and properties of common materials used as fuels, their physical and chemical properties; canning materials; coolants; control rods; reflectors and shielding materials. Production of reactor materials.

UNIT - IV

Indian resources: Occurrence and general characteristics of nuclear minerals. Flow sheets of processing of nuclear minerals for the production of nuclear grade uranium, thorium, beryllium and zirconium with emphasis on basic scientific principles involved.

UNIT - V

Production and enriched uranium and fabrication of fuel elements. Irradiated fuel processing for recovery of Plutonium. Nuclear power production in India and its economics and safety measures.

TEXT BOOKS:

1. Wright JC -Metallurgy in Nuclear Power Technology; Iliffe Book Ltd., 1962
2. Glasstone S and Snesonske A; Principles of Nuclear Reactor Engineering; Macmillan, London

REFERENCE BOOKS:

1. Wilkinson WD and Mrphy WF Nuclear Reactor Metallurgy Van Nostrand 1958
2. Symposium on Rare matierals; Indian Institute of Metals.
3. Gurinsky DH and Dienes JL Nulcears Fuels, Macmillan.
4. Proceedings of the symposium on Nuclear Science and Engineering – Bhabha Atomic Research Centre, Bombay.

MM513PE: FATIGUE AND FRACTURE MECHANICS (Professional Elective – I)

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To study the different types of fatigue failures and their mechanisms in the engineering applications
- To study the basic theory of fracture mechanics and its relationship with fatigue and creep failure mechanisms
- To understand the damage tolerance approach in the life estimation of structures

Course outcomes: After completing this course, the student will have:

- The ability to identify the characteristic fatigue failures in the engineering structures
- Knowledge of connecting fracture mechanics concepts to fatigue failure
- Knowledge of fatigue failure mechanisms in non-metallic materials

UNIT - I

Introduction and historical overview, 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 and propagation, Mechanisms, 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, Multi axial stresses, Thermo mechanical loading, Variable amplitude loading, Load sequence, Crack closure.

UNIT - IV

Fatigue behaviour of different materials – Metallic materials and weldments, Ceramics, Polymers, Composites, Metallic glasses, Shape memory alloys,

UNIT - V

Fatigue behaviour of ultrafine grained materials, Nano crystalline materials, Biomaterials, Metallic foams 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. Dieter
2. Thomas. H. Courtney

MM504PC: MECHANICAL WORKING OF METALS LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	3	1.5

Course objectives: This lab course is designed to know the various testing methods for evaluation of metal forming techniques

Course outcomes: Upon successful completion of this course, the student will be able to

- Determine strain hardening exponent from the stress-strain diagram.
- Understand the difference between simple, progressive and compound dies.
- Understand the effect of cold working and annealing on microstructure.
- Illustrate the effect of friction and semi die –angle on metal flow in extrusion.
- Practice various deformation processes like extrusion, deep drawing and redrawing.

LIST OF EXPERIMENTS:

1. To determine the formability of given materials by Erichson cup test
2. To manufacture washer components using fly press (progressive dies /compound dies)
3. Deep drawing of a cup with / without blank holder by hydraulic press
4. Redrawing of a cup with / without blank holder by hydraulic press
5. To determine the friction factor by ring compression test
6. Determination of strain hardening exponent ‘n’ and strength coefficient ‘k’
7. To verify Hall-Petch relation in MS specimen.
8. To determine the effects of cold working on the microstructure and mechanical properties of given metal.
9. To demonstrate the effect of friction and height-to-diameter ratio in the axi-symmetric compression of a cylinder.
10. To analyze the load and metal flow in extrusion with different friction conditions and semi-die angles.

List of Equipment:

1. UTM, 2. Hydraulic press, 3. Fly press, 4. Erichson cup Tester

MM505PC: EXTRACTIVE METALLURGY LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	3	1.5

Course objectives: The basic objective of the course is to provide hands on practice on various types of unit process industrially important nonferrous metals

Course outcome: Upon successful completion of this course, the student will:

1. Understand pyrometallurgical extraction concepts like roasting, calcination
2. Realize Hydrometallurgical extraction fundamentals
3. Understand the elctro-metallurgical extraction concepts

List of experiments:

1. To find the efficiency of electrolytic cell for Cu refining
2. To find the effect of time on leaching of an oxide ore
3. To find the effect of temperature on leaching of an oxide ore
4. To conduct cementation of Copper ore
5. Electro wining of a nonferrous metal
6. To determine the effect of temperature on calcination of lime stone
7. To find the effect of time on calcination of lime stone
8. To find the weight loss on calcination of lime stone
9. To find the effect of time on roasting of a sulphide ore
10. To find the effect of temperature on roasting of a sulphide ore

List of equipment:

1. Muffle Furnace, 2. Oxygen Cylinder, 3. Digital electronic balance, 4. Ceramic crucible, 5. Electrochemical cell

MM506PC: ENVIRONMENTAL DEGRADATION OF MATERIALS LAB

B.Tech. III Year I Sem.

L	T	P	C
0	0	2	1

Course Objective: This lab course is designed to conduct the experiments on electrodeposition, verification of Faraday's laws and evaluation of factors affecting on corrosion

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.

LIST OF EXPERIMENTS:

1. Study the effect of concentration and temperature on conductivity of an aqueous electrolyte (NaCl)
2. Verification of Faraday's laws
3. Electroplating of copper on brass and to study the influence of current density on current efficiency.
4. Electroplating of Nickel using watt's bath and to study the influence of current density on current efficiency
5. Electroplating of chromium on mild steel and to study the influence of current density on current efficiency.
6. To anodise the given aluminium sample and observation of microstructure
7. To understand the principles in galvanic cell corrosion using "Ferroxyl" indicating test solution.
8. To determine the throwing power of electroplating bath
9. To study the intergranular corrosion of Austenitic stainless steels
10. To conduct electropolishing of stainless steel using Nitric acid batch.

List of equipment:

1. Rectifier 2. Ammeters 3. Rheostats 4. D C Regulated Power Supply instrument 5. Electropolishing Equipment 6. Multimeters 7. Conductometers 8. Digital weighing balance

***MC510: INTELLECTUAL PROPERTY RIGHTS**

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	0

UNIT – I

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

UNIT – II

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

UNIT – III

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

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

UNIT – IV

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

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

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

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

TEXT & REFERENCE BOOKS:

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

MM601PC: MATERIALS CHARACTERIZATION

B.Tech. III Year II Sem.

L	T	P	C
3	1	0	4

Course objectives:

- To obtain knowledge on various structural and microstructural characterization techniques of materials.
- To study the principles, theory and practice of various characterization techniques

Course Outcomes: After completing this course the student will be able to:

- Determine crystal structures of materials
- Analyze microstructure of materials at different length scales
- Analyze defects and fracture surfaces of the tested materials
- Indicate instrumentation associated with and operating principles of various techniques

UNIT - I

Optical Microscopy: Principle, Image formation, Resolving power, Numerical aperture, Magnification, Depth of focus, Components of microscope, Important lens defects and their corrections, Resolving power and Magnification, Principle of phase contrast, Interference and Polarized light microscopy, Elements of quantitative, Metallography and Image processing.

UNIT - II

Scanning Electron Microscopy: Principle, Interaction of electron beams with matter, Construction and Working principle, Working Distance, Depth of field, Depth of focus and Spot Size, Specimen preparation, Different types of modes used in SEM (SE and BSE) and their applications, Advantages, limitations and applications.

UNIT - III

Transmission Electron Microscopy: Principle, Construction and Working principle, Resolving power and Magnification, Depth of field and Depth of focus, Bright and dark field, Specimen preparation, Selected area diffraction (SAD), Applications, Advantage and Limitations.

UNIT - IV

X-Ray Diffraction: Introduction, Production and properties of x-rays, Bragg's law of diffraction, Experimental methods, Intensity of diffracted beams - Scattering by an electron by an atom, by a unit cell, structure-factor calculations, factors affecting diffraction intensities.

UNIT - V

Applications of XRD: Orientation of single crystals, Effect of plastic deformation, the structure of polycrystalline Aggregates, Determination of crystal structure, Precise lattice parameter measurements, Phase - diagram determination, Order-disorder transformation, Chemical analysis by Diffraction, Stress measurement.

TEXT BOOKS:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Lang – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials – David Brandon, Wayne D Kalpan, John their applications, Advantages, limitations and applications.

REFERENCE BOOKS:

1. The Principles of Metallographic Laboratory and Practices (Metallurgy) – George L. Khel-McGraw- Hill, 1949.

2. Experimental Techniques in Materials and Mechanics – C. Suryanarayana, CRC Press, Taylor & Francis Group, 2011.
3. Metallography: Principles and Practices – George F. Vander Voort, ASM International, 1984 – Technology & Engineering
4. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall, 2001 – Science.

MM602PC: NON-METALLIC MATERIALS

B.Tech. III Year II Sem.

L	T	P	C
3	1	0	4

Course objectives:

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

Course outcomes: After completing this course the student can:

- List the prominent non-metallic materials available for engineering applications
- Indicate the uses for which these materials are preferred
- Indicate the structure property relations in these materials
- Indicate the synthesis and processing steps associated with these materials

UNIT - I

Definition and classification of nonmetallic materials, comparison of properties of metals and nonmetallic materials. Introduction to Polymers: Concept of polymers, types of polymers reactions, Mechanism of polymerization, Synthesis, properties and application of some of the significant polymers viz., PVC, PAN, PMMA, and Teflon

UNIT - II

Ceramics: Introduction, classification, structure, and applications of ceramics. Brief introduction to some of the Ceramic processing techniques. Special ceramics: ferroelectric, piezoelectric, magnetic, superconducting, laser and bio-ceramics.

UNIT - III

Glasses: Introduction, formation of glasses, structural features of glasses, classification, processing and applications of glasses. Manufacturing methods of glasses.

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. Composite Materials: 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.

MM603PC: MATERIAL PROCESSING (CASTING & WELDING)

B.Tech. III Year II Sem.

L	T	P	C
3	1	0	4

Course objectives: This course is mainly intended to introduce and explain various moulding, casting techniques and equipment used. Principles of Solidification of casting, defects in castings and their remedies are also dealt in detail. 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.

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

- Understand basics of metal casting, casting defects and remedies.
- Design gating system for metal casting processes
- Understand the casting technology, solidification of metals and alloys.
- Understand the basics of various metal joining processes
- Understand weldability of cast iron and high carbon steel and weldability characteristics.

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. Inspection and Testing of castings.

UNIT - III

Melting and Solidification: Cupola and Induction Melting. Nucleation and growth. Freezing of metals and alloys. Dendritic freezing. 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 Electron Beam Welding, Laser welding, Solid state welding, Friction stir welding, and explosive welding processes.

UNIT - V

Weldability, Microstructure of fusion zone and heat affected zone. Influence of heat input, thermal and residual stresses, pre heat and cooling rate, PWHT. Weldability of high carbon steel, cast irons, stainless steels use of Schaeffler diagram and Delong diagrams. Welding of non-ferrous alloys - Aluminum alloys, Welding of dissimilar metals.

TEXT BOOKS:

1. Principles of Metal casting by Heine – Loper and Rosenthal, Tata McGraw Hill, 2nd Edition.
2. Metal Casting: Principles and practice – T.V. Ramana Rao, New Age International, 2007.
3. Welding Technology – R.S. Parmar

REFERENCE BOOKS:

1. Metals Handbook Vol. 5 published by ASM, Ohio.
2. Manufacturing Technology – Vol. I: Foundry, Forming and Welding, P.N.Rao, McGraw Hill 3rd Edition.
3. Castings – John Campbell – Second Edition – Elsevier.
4. Welding Metallurgy - JF Lancaster

MM611PE: NANO MATERIALS (Professional Elective - II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- This course is primarily intended to expose the students to a highly interdisciplinary subject.
- This would emphasize on the classification, synthesis and applications of Nano materials.

Course outcomes: After completing this course, the student should be able to:

- Indicate the differences between nanomaterials and conventional materials
- Indicate how specific synthesis techniques can result in nanomaterials
- Give examples of specific nanomaterials and explain the scientific reasons for the properties displayed by them
- Describe how specific characterization techniques can be used to analyze nanomaterials

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 structures and Nano materials: Synthesis, properties and applications - Guozhong Cao-Imperial College press in 2004, 2nd edition.
2. Text book of Nano Science and Technology, B S Murthy, Universities press-IIM series in Metallurgy and Material Science

REFERENCE BOOKS:

1. Springer Handbook of Nanotechnology
2. Nano Materials Synthesis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandhopadyay/ New age Publications
4. Nano Essentials T Pradeep / TMH

MM612PE: ELECTRONIC MATERIALS (Professional Elective - II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

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

Course Outcomes: After completing this course, the student will be able to:

- Indicate and explain important scientific parameters associated with electronic materials
- Describe different semiconductors and their properties with examples
- Explain the features and functioning of several electronic devices
- Describe the manufacturing processes associated with electronic materials and devices

UNIT - I

Review of quantum mechanics: Electron as waves and particles; Wave-function; Electron as a plane-wave, Schrodinger Equation, DC conductivity in metals. Wigner-Seitz cell; k-space: 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

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. Band diagrams, direct and indirect bandgap, applications of semiconductors;

UNIT - III

Intrinsic semiconductors: Maxwell-Boltzman equation; Law-of mass-action; Direct vs Indirect Semiconductors, Extrinsic-semiconductor: n- and p-type semiconductors; Degenerate and non-degenerate semiconductors. p-n junction and solar cells; Bandgap engineering: Solid-state LEDs, Lasers and IR detectors. Dia, para and, Ferro magnetism, ferrites, magnetic hysteresis, Applications.

UNIT - IV

Ionic conduction, conduction in glasses; Effect of stoichiometric and extrinsic defects on conduction, Applications in sensors and fuel cells. Dielectric constants and polarization, linear dielectric materials, capacitors; Polarization mechanisms; Non-linear dielectrics, pyro- , piezo-, and ferro-electric properties, hysteresis and ferroelectric domains; Applications in sensors, actuators and memory devices.

UNIT - V

Semiconductor manufacturing, 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. “Electronic Properties of Materials” by R. E. Hummel, Springer, 2017.

REFERENCE BOOKS:

1. Advanced Theory of Semiconductor Devices, Karl Hess, Prentice Hall, 1988
2. Advanced Semiconductor Fundamentals, Robert F. Pierret as part of Modular Series on Solid State Devices Vol. 6, Addison Wesley, 1989
3. Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons 1991
4. Electrical Properties of Materials, L. Solymar and D. Walsh, Oxford University press, 1998.
5. Physics of Solids, C. A. Wert and R. M. Thomson, McGraw-Hill Book Company, 1970 or later

MM613PE: FURNACE TECHNOLOGY AND PYROMETRY (Professional Elective - II)

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To explain the phenomenon of heat transfer by conduction, convection, radiation and to study the working of various types of furnaces.
- To study the principles of temperature measurement by various methods.

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

- Apply the various methods of heat transfer and solve problems.
- Can apply /select a suitable pyrometer for high temperature measurements under various conditions.
- Will be able to select / have knowledge about a particular furnace details and applications.

UNIT - I

Steady State Heat Transfer: Importance of heat transfer, conduction through plane, cylindrical, spherical and compound walls, shape factor and effect of variable thermal conductivity. Unsteady state conduction: Thermal diffusivity equation for uni-directional heat flow. Sudden change of surface temperature of a thick plane wall, cylinder and sphere. Graphical Solutions.

UNIT - II

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. Types of Heat exchangers on mode of travel. Log mean temperature difference for both parallel and counter flow exchangers. Radiation - emissivity-luminous and non-luminous flames. Radiant exchange between parallel surfaces enclosed body and enclosure. Combined effect of conduction, convection and radiation. Thermal efficiency of insulation.

UNIT - III

Furnaces: Characteristic features of vertical shaft furnaces, reverberatory furnaces, Electric Arc and Induction furnaces. Tube and muffle type resistance furnaces, continuous furnaces. Sources of heat losses in furnaces and heat balance.

UNIT - IV

Pyrometry: Thermo electric pyrometer- Peltier and Thomas e.m.f's. Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f by Milli-voltmeters and potentiometers. Cold junction correction. Resistance thermometers – Calendars correction. Principle, construction of resistance thermometers. Measurement of resistance compensation for connection wires.

UNIT - V

Optical pyrometers-principle involved in optical pyrometers, Black body conditions. Wiens and Plancks laws of monochromatic radiation. Principle and construction of disappearing filament optical pyrometer (morse type). F and F optical pyrometer (Wedge type) and Pyro optical pyrometer. The effect of the distance between pyrometer and source, Emissivity of materials. Absorbing media and reflection of optical pyrometer readings. Total radiation pyrometer: Principles, construction of ferry radiation pyrometer, ferry metal spiral radiation pyrometer, fixed focus radiation pyrometer (foster Pyrometer) and pyrometer.

TEXT BOOKS:

1. Elements of heat transfer- Jakob & Hawikns.

2. Pyrometry - W.P. wood & J. M. Corck

REFERENCE BOOKS:

1. Furnaces-J. D. Gilchrist, First edition, Published by Pergamon press.
2. Elements of thermodynamics& heat transfer- Obert & Young.
3. Control systems & Instrumentation – S. Bhasker.

MM604PC: MATERIAL PROCESSING LAB (CASTING & WELDING)

B.Tech. III Year II Sem.

L	T	P	C
0	0	3	1.5

Course objectives: This lab course is designed to provide hands on experience on various foundry testing methods for evaluation of moulding sand properties, also designed to make the student to understand and demonstrate the various types of welding processes and its variables.

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Determine moulding sand dry, hot and green strength
- Understand the preparation of moulding sand
- Determine moulding sand properties by varying additives
- Understand the Melting of Al alloys
- 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.

LIST OF EXPERIMENTS:

1. Preparation of gating system using green sand moulding.
2. Study of permeability of green sand with clay and water.
3. Determination of sand properties: green and dry strength, green and dry hardness, hot shear strength with variation in sand additives.
4. Determination of clay content in sand.
5. Determination of the shatter index of green sand
6. Melting of Al alloys in a pit furnace and casting into light components
7. Preparation of a shell by shell moulding process
8. Study and observe the identification of flames using gas welding techniques and prepare a Butt joint with gas welding.
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 submerged arc welding (SAW) process.
13. Preparation of a butt joint with mild steel plate using MIG welding process.
14. Evaluation of microstructure of welded joint and observe the structural difference in weld zone, heat affected zone (HAZ) and base metal

LIST OF EQUIPMENT:

1. Mould Boxes, Patterns, Core Boxes, Tool Boxes. 2. Sieve Shaker 3. Permeability Apparatus. 4. Universal Sand testing Machine with Accessories. 5. Sand Hardness tester. 6. Clay Content Apparatus 7. Shatter Index test apparatus. 8. Pit Furnace/ Electric Furnace 9. Shell Moulding Machine 10. Centrifugal Casting Machine 11. Ultrasonic Tester. 12. Ladles, Crucibles and other Accessories. 13. Muffle Furnace 1000^0c 14. Centrifugal Casting Machine 15. Gas welding equipment. 16. Spot welding Machine 17. TIG Welding Machine 18. Arc welding Machine. 19. MIG welding Machine 20. Submerged Arc Welding machine

MM605PC: MODELING AND SIMULATION LAB FOR METALLURGICAL AND MATERIALS ENGINEERING

B.Tech. III Year II Sem.

L	T	P	C
0	0	3	1.5

Course objectives: This course is designed to impart hands-on experience on the various modelling and simulation techniques used in metallurgical and materials engineering.

Course outcomes: Students will acquire a hands-on training on

- Different computational, modelling and simulation techniques.
- Students will know the importance of Metallurgical Computations, modelling and simulation techniques for supplementing experiments for understanding of materials behaviour.

List of experiments:

1. Computing heat and mass calculations of chemical reactions
2. Determination of Crystal structures using computer principles
3. Programming of pressurized and non-pressurized Gating system
4. Programming on calculation of electrode potential at nonstandard conditions
5. Programming of Riser system
6. Programming to determine the charge input to get the required output of pig iron in a blast furnace.
7. Computation of binary phase diagrams
8. Computation of Pour-baix diagrams

TEXT BOOKS:

1. Computer oriented Numerical methods – V. Rajaraman (PHI Publicatons)
2. Computer programming and Numerical methods – S. Saran
3. Numerical methods in engineering – Mario G. Salvadori and Melvin L. Baron
4. Matrix operation on Computer – L.L. Brirud (LCUE Publication)

EN608HS: ADVANCED COMMUNICATION SKILLS LAB

B.Tech. III Year II Sem.

L	T	P	C
0	0	2	1

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized 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 Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

REFERENCES:

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

***MC609: ENVIRONMENTAL SCIENCE**

B.Tech. III Year II Sem.

L	T	P	C
3	0	0	0

Course Objectives:

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

Course Outcomes:

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

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

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

UNIT - V

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

MM701PC: INTRODUCTION TO INSTRUMENTATION

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

AIM: To study the basic instrumentation methods

Course Objectives: To have a knowledge of:

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

Course Outcomes:

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

UNIT - I

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

UNIT - II

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

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

TEXT BOOKS:

1. Alan S. Morrris. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999
2. Ernest O Doeblin. Measurement Systems Application & Design, Tata McGraw 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.
4. Liptak B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994

MM711PE: ALTERNATE ROUTES OF IRON & STEEL MAKING (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To learn alternate routes of iron making based on coal based and gas-based processes.
- Gain knowledge about important smelt reduction processes.
- To enhance the technical knowledge in secondary steel making processes.

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

- Comprehensive understanding of alternate routes to iron making concomitant to kinetics of reduction of oxides of iron.
- Knowledge about smelt reduction processes.
- Knowledge about the importance of secondary steel making processes and types of processes.

UNIT- I

Basics of iron and steel productions. The need for alternative routes, fundamentals of direct reduction, applications of DRI.

UNIT- II

Coal based DR processes; Rotary Kiln, Fast met, ITMK 3 process. Gas based DR processes: HYL process, Finmet, HIB process.

UNIT- III

Smelting Reduction Processes: Introduction, need and significance of smelting reduction. Classification of SR processes. Raw materials, advantages and limitations, fundamentals of SR process, Details about COREX, fast melt Processes.

UNIT - IV

Secondary Steel Making process, introduction, objectives, types, advantages and limitations.
Stirring techniques, synthesis, slag refining, injection metallurgy.

UNIT-V

Vacuum treatment of steel, RH process and DH process, post solidification treatments, ESR and VAR process.

TEXT BOOKS:

1. Sponge Iron Production by direct Reduction of Iron oxide, by Amit Chatterjee. PHI learning Pvt Ltd. M.D. 2nd Edition.
2. Hot Metal production by smelting reduction of Iron oxide, by Amit Chatterjee. PHI learning Pvt Ltd.
3. Ahindra Ghosh: Secondary steel Making – Principles and Applications, CRC press, 2001.

REFERENCE BOOKS:

1. Amit Chatterjee: Beyond the Blast Furnace, CRC press, 1992.
2. Steel Making – A.K. Chakrabarti. PHI.

MM712PE: BIO MATERIALS (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the student to the range of biomaterials and the science and engineering of biomaterials.
- To understand constraints associated with the use of biomaterials.

Course Outcomes: After completing the course, the student will be able to:

- Explain the types of Biomaterials and their relative advantages and disadvantages
- Indicate the constraints placed on the use of materials in biological environments
- Explain the characterization of materials from the perspective of application as a biomaterial

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. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.
2. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.

REFERENCE BOOKS:

1. Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
2. Biological Performance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
3. Basic Cell Culture: A Practical Approach, Edited by J.M. Davis, IRL Press, Oxford University Press, New York, 1994.

MM713PE: NON-DESTRUCTIVE TESTING (PE – III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: The objective of the course is to introduce various non-destructive evaluation techniques applied to impact and test quality of manufacture products obtained by various manufacturing techniques such as welding, rolling, forging, casting, powder metallurgy etc. This subject also provides certification aspects of commercial products.

Course Outcomes: Upon completion of this course, the student will be able to:

- Decide, select, use and interpret proper nondestructive methods for inspection and evaluation of engineering materials
- Evaluate the materials and structures for the causes of discontinuities, which interfere with the usefulness of the part
- Design nondestructive methods for inspection and evaluation of materials
- Design nondestructive methods for systems for quality assurance including production processes and assemblies

UNIT - I

Introduction, visual methods**:** Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection. Other methods, Acoustic Emission methods, Acoustic methods, Leak detection, Thermal inspection.

UNIT - II

Penetrant flaw detection**:** Principles, Process, Penetrant systems, Liquid-penetrant materials, Emulsifiers, cleaners developers, sensitivity, Advantages, Limitations, Applications. Magnetic methods**,** Advantages, Limitations, Methods of generating fields, magnetic particles and suspending liquids Magnetography, field sensitive probes, applications. Measurement of metal properties.

UNIT - III

Radiographic methods: Limitations, Principles of radiography, sources of radiation, Ionising radiation - X-rays sources, Gama-rays sources Recording of radiation, Radiographic sensitivity, Fluoroscopic methods, special techniques, Radiation safety.

UNIT- IV

Ultrasonic testing of materials: Advantages, disadvantages, Applications, Generation of. Ultrasonic waves, general characteristics of ultrasonic waves, methods and instruments for ultrasonic materials testing, special techniques.

UNIT - V

Electromagnetic testing: Magnetism, Magnetic domains, Magnetization curves, Magnetic Hysteresis, Hysteresis-loop tests, comparator - bridge tests Absolute single-coil system, applications. Electrical methods, Eddy current methods, potential-drop methods, applications, Thermal Imaging

TEXT BOOKS:

1. Non-Destructive Testing by P. Halmshaw
2. Practical Non Destructive testing, Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing, 2002

REFERENCE BOOK:

1. ASM Metals Handbook, Nondestructive inspection and quality control.

MM721PE: FUNCTIONAL MATERIALS (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:
To introduce the student to functional materials and the science behind the performance of the functional material. To enable the student to understand the applications of functional materials

Course outcomes: After completing the course the student will be able to:
- Indicate the various type of functional materials
- Explain the principle of operation of the functional material
- Indicate the applications of the functional 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, 2. Diode, 3. MOS device capacitor 4. MOS transistor structure and operation and 5. Transistor formation and 6. 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

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.

MM722PE: COMPUTATIONAL MATERIALS ENGINEERING (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course objectives: This course introduces computational methods in the domain of metallurgical and materials engineering.

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

- Analyse a metallurgical problem to create a well posed numerical problem
- Identify initial and boundary conditions of a problem relevant to materials domain
- Propose a solution procedure for a numerical problem in the domain of materials engineering
- Demonstrate ability to quantify a materials engineering problem through numerical analysis

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/CO2 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 Nonlinear 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. Modeling in materials processing – J.A. Dantzig and C.L. Tucker III, Cambridge University Press (2001)
2. H. K. Versteeg, W. Malalsekera, “An Introduction to Computational Fluid Dynamics”, Longman Scientific and Technical, 1st Edition 1995.
3. S.C. Chapra, R.P. Canale, “Numerical Methods for Engineers”, McGraw Hill India Pvt. Ltd.,5th Edition, 2002
4. Santosh K. Gupta: Numerical Methods for Engineers, New Age International (P) Limited, New Delhi, 1998

RELATED LINKS:

- http://www.gnu.org/software/octave/
- http://gcc.gnu.org/codingconventions.html

MM723PE: CERAMICS SCIENCE AND TECHNOLOGY (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: This course is intended to provide in depth knowledge on processing ceramic materials including structure, properties, phase transformations, applications, and fabrication methods of ceramics.

Course outcomes: Through this course, the student will be able

- To compare ceramics and understand their superiority over metals and other materials in some specific and critical applications.
- The student would also be benefited by understanding the various applications of ceramic materials in real time engineering.
- The student will be understanding various manufacturing techniques of ceramic materials.

UNIT - I

Introduction and Crystal structures: Definition, Classification of Ceramics, Traditional Ceramics, Structural Ceramics, Ceramic super conductors. Crystal structures in Ceramics, Grouping of ions and Pouling's rules, Oxide structures, Silicate structures, Glass formation, Models of glass structure Types of glasses.

UNIT - II

Equilibrium Diagrams of ceramic systems: Two component systems like $Al_2O_3 – SiO_2$ and $BaO – TiO_2$; and Three component systems $MgO – Al_2O_3 – SiO_2$

UNIT - III

Synthesis of Ceramic powders, microstructure, mechanical, Thermal, electrical, optical, magnetic, and chemical properties of ceramic materials

UNIT - IV

Powder Preparation Techniques: Sol-gel technology – Precipitation, Coprecipitation and Hydrothermal precipitation techniques. Preparation of Al_2O_3, ZrO_2, SiC, Si_3N_4 BN & B_4C.

UNIT - V

Ceramic Processing Techniques: Hot Pressing, Hot Isostatic Pressing, (HIP). Spark Plasma Sintering. Sintering, Sinter / HIP, Injection moulding, Slip casting, Tape casting, Gel casting, Extrusion.

TEXT BOOKS:

1. Introduction to Ceramics, W.D. Kingery et al, John Wiley
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCE BOOKS:

1. FINCER proceedings of workshop on fine ceramics synthesis, properties and applications, T.R. Rammohan et al.
2. Hand Book of Fibre, reinforced composite materials, Ed. Lubin.
3. Fundamentals of Ceramics, M W Barsoum
4. Ceramics, Mechanical Properties, Failure Behaviour, Material Selection, D. Munz & T. Fett
5. Ceramic Science and Technology, Vol. 2 Material Selection and Properties Ed., Ralf Riedel and I, Wei Chen, Wiely, VCH

SM701MS: FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objective:

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

Course Outcome:

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

UNIT- I:

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

UNIT - II:

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

UNIT- III:

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Job Satisfaction, Job Enrichment, Job Enlargement, Talent Management, Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT- IV:

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT- V:

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

TEXT BOOKS:

1. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
2. Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.

REFERENCE BOOKS:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
3. Industrial Engineering and Management: Including Production Management, T.R. Banga, S.C. Sharma, Khanna Publishers.

MM811PE: ADVANCED MANUFACTURING TECHNOLOGIES (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

Course Outcomes:

- To understand the various manufacturing technologies for different materials.
- To correlate between manufacturing technology and the properties of Materials.
- To understand the Relationship between materials selection, processing and applications.

UNIT - I

Identification of processing parameters: Dynamic materials modeling and definition, safe processing zones, identification of safe window of processing

UNIT - II

Bulk deformation process: Isothermal forging, disc, ring rolling, incremental forging

UNIT - III

Powder process: Spray forming, Hot Isostatic Pressing (HIP), hot pressing and extrusion

UNIT - IV

Advanced Casting process: Full mold casting, Investment casting, Continuous casting and Vacuum casting

UNIT - V

Other Techniques: Rapid prototyping, severe plastic deformation techniques

TEXT BOOKS:

1. Advanced Techniques to Evaluate hot workability of materials - KP Rao, YVRK Prasad, Volume 3 - Comprehensive Materials Processing, Elsevier
2. Handbook of Workability and Process Design- G.E. Dieter, SL Semiatin

REFERENCE BOOKS:

1. Rapid protoyping of materials - Marquis FDS
2. Rapid prototyping and manufacturing Fundamentals and Stereo Lithography- PF Jacobs
3. Rapid prototyping: Laser based and Other technologies- PK Venu vinod
4. Hot Working Guide - A compendium of processing Maps -Authors - YVRK Prasad, Sasidhara
5. ASM Handbook Volume -7 Powder Metal Technology & Applications

MM812PE: DESIGN AND SELECTION OF ENGINEERING MATERIALS (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service

Course outcomes: Upon successful completion of the course, student will be

- To understand the criteria for selection of materials
- To understand the effect of composition, processing route and structure on materials properties.
- To understand the relationship between requirements of the materials for selection, processing and its applications

UNIT - I

Materials selection process: Criteria for selection of materials

UNIT - II

Effect of composition, processing and structure on materials properties Concepts in the design of industrial components

UNIT - III

Properties vs Performance materials: Aerospace and defence applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, intermetallics, Aluminides

UNIT - IV

Manufacturing aspects of design, Nuclear application: radiation damage, effect of radiation damage on Yield stregth, Tensile Strength, Impact Strength, DBT Temperatures, design of an alloy for fission and fusion reactors.

UNIT - V

Materials aspects of design: Selection and design of polymers, ceramics and composites for specific applications,

TEXT BOOKS:

1. Material Selection and Design, Vol 20, ASM Hand Book, ASM International
2. M.F. Ashby, Materials Selection in Mechanical Design, Pergamon Press, 1992
3. G.E. Dieter, Engineering Design, A Materials and Processing Approach, 2nd ed., McGraw-Hill, 1991

REFERENCE BOOKS:

1. V. John, Introduction to Engineering Materials, 3rd ed., Industrial Press, 1992
2. T.H. Courtney, Mechanical Behavior of Materials, McGraw-Hill, 1990
3. J.R. Dixon and C. Poli, Engineering Design and Design for Manufacturing, Field Stone Publishers, 1995
4. Surface Engineering, Vol 5, ASM Handbook, ASM International, 1994
5. H.O. Fuchs and R.I. Stephens, Metal Fatigue in Engineering, John Wiley & Sons, 1980
6. S.T. Rolfe and J.M. Barsom, Fracture and Fatigue Control in Structures, 4th ed., Prentice-Hall, Inc., 1996

MM813PE: COMPOSITE MATERIALS (PE – V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- Develop understanding of the structure of ceramic materials on multiple length scales.
- Develop knowledge of point defect generation in ceramic materials, and their impact on transport properties.
- To describe key processing techniques for producing metal, ceramic-, and polymer-matrix composites.
- To demonstrate the relationship among synthesis, processing, and properties in composite materials.

Course Outcomes:

- Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
- Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure.
- Able to select matrices for composite materials in different applications.
- Able to describe key processing methods for fabricating composites.

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al_2O_3, SiC, 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 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

Micromechanics 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.

TEXTS 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

MM821PE: FAILURE ANALYSIS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- Gain an understanding of fundamentals of fracture mechanics, Griffith crack theory.
- Analyze the crack behavior in various conditions.
- Obtain a working knowledge of failure analysis.

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

- Apply the knowledge of fracture mechanics under various conditions.
- Awareness about crack formation and crack growth in materials under various conditions.
- Able to analyze and take remedial steps in case of failure by fracture.

UNIT - I

Introduction to fracture mechanics: Fracture criteria, theoretical strength, stress-concentration factor, Griffith crack theory, strain-energy release rate.

UNIT - II

Mechanism of fracture: introduction, cleavage fracture, ductile fracture, fatigue cracking, environment assisted cracking, evaluation of fracture toughness. Introduction to LEFM: Concept, analysis of simple crack problems, nucleation and propagation of cracks, correlation between microstructure and fracture behaviour in different materials.

UNIT - III

Crack behaviour in elastic-plastic materials, effect of strain rate, environment, temperature, and irradiation on fracture behaviour of materials. Application of fracture mechanics to material selections, alloy design, and design of structures.

UNIT - IV

Conventional approach to fatigue crack growth in reactive environment, static and cyclic loading.

UNIT - V

Failure analysis: failure analysis methodology, failure types and characteristics, and concept of failure mechanism. Tools and techniques of failure analysis, case studies: in-process failure and service failure conditions.

TEXT BOOKS:

1. Fracture Mechanics: Fundamentals and Applications, T. L. Anderson, CRC Press, Inc., 1995.
2. Fracture and Fatigue Control in Structures, S.T. Rolfe and J.M. Barsom, Prentice-Hall, 1972.
3. Case Histories in Failure analysis, ASM, Ohio, 1979.

REFERENCE BOOKS:

1. ASM Handbook: Fatigue and Fracture, S. R. Lampman, (Rechnical Ed.) ASM International, 1996.
2. Elementary Engineering Fracture Mechanics, David Broek, Scjtoff & Noordhoff, 1978.
3. Failure analysis- R W Hertzberg, Deformation of Fracture Mechanics of Engineering Materials-John Wiley& Sons publications (1995).

MM822PE: ENERGY MATERIALS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

- To learn the operating principle of several environmentally friendly energy technologies.
- To identify the material issues relevant to these technologies and to evaluate various operational aspects associated with these technologies.

Course Outcomes: After completing this course the student should be able to:

- Evaluate an energy technology for environmental friendliness
- Explain the operating principle of several energy technologies
- Indicate the material requirements for these energy technologies
- Demonstrate the ability to understand the characterization, performance, and failure data related to 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

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 BOOK:

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 2004

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.

MM823PE: SUPER ALLOYS (PE – VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: The prime objective of the course is to make the students understand various superalloys applied in nuclear, aerospace and space Industries.

Course outcomes: Acquiring knowledge on the course,

- The student will be able to select demonstrate the physical metallurgy and properties of super alloys
- To understand the manufacturing and behaviour of the alloys at elevated temperatures.
- Gain the required knowledge for selecting the superalloys for specific applications

UNIT - I

Introduction to superalloys, Guide to selection of superalloys, wrought superalloys, Heat Resistant alloys. Physical Metallurgy; Microstructure of wrought Heat-Resisting Alloys, Microstructure of Ni-base & Co-base heat-resistant casting alloys. temperature and time-dependent transformation. Application to heat treatment of high temperature alloys.

UNIT - II

Relationship of properties to Microstructure in superalloys. Fracture properties of superalloys. High temperature corrosion and use of castings for protection. Effect of Physical Metallurgy and process variables on the microstructure of wrought superalloys. Process and Metallurgical factors affecting on superalloys and other high temperature materials.

UNIT - III

Melting Process**;** Melting of Superalloys; Principles and practices of vacuum Induction Melting and Vacuum Arc melting

UNIT - IV

Forming Methods**;** Forming and Fabrication of superalloys; Recent developments in P/M of superalloys-Production of components by Hot-Isostatic Pressing

UNIT - V

Casting methods - Improving turbine blade performance by solidification control -the development of single crystal turbine blades. Quality of super alloy castings; Heat Treating of Heat resistant alloys

TEXT BOOKS:

1. Superalloys; Source book; Mathew J. Donachie. Jr. editor; 1984.
2. The superalloys; edited by Chester T. Sims and William C Haagel; 1972

REFERENCE BOOKS:

1. Campbell IE High temperature MATERIALS, John Wiley and sons Inc.; 1956
2. The superalloys: fundamentals and applications By Roger C. Reed
3. Superalloys: a technical guide - Elihu F. Bradley-1988-280 pages
4. Superalloys A Technical Guide, Methew J. Donachie, Stephen J. Donachie