## JNTUH COLLEGE OF ENGINEERING

# VISION

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

## MISSION

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

# CHEMICALENGINEERING DEPARTMENT

### VISION:

To promote the growth of Chemical Engineering in addressing the needs of academia, industry and society through quality education and innovative research.

# **MISSION:**

- 1. To provide a comprehensive learning ambience in Basic Sciences, Chemical Engineering and related Engineering fields.
- 2. To encourage principles of sustainability and stimulate the evolution of environmental friendly techniques for the benefit of society.
- 3. To promote qualities of leadership and team work in students to become successful entrepreneurs.

# **PROGRAM EDUCATIONAL OBJECTIVES:**

- 1. Achieve innovation in research, education and administration and able to work in collaborative environment.
- 2. Obtain good and higher career positions in prestigious organizations.
- 3. Exhibit high ethical standards, professional team work and continuous learning to cater to the ever changing needs of the society.
- 4. To pursue professional and personal development through right knowledge, skills and attitude.

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

#### I Year

#### I Semester

S.No.	<b>Course Code</b>	<b>Course Title</b>		Т	Р	Credits
1	BSC	Engineering Mathematics		1	0	4
2	BSC	Engineering Physics	3	1	0	4
3	ESC	Programming for Problem Solving		0	0	3
4	ESC	Engineering Graphics		0	4	3
5	BSC	Engineering Physics Lab		0	3	1.5
6	ESC	Programming for Problem Solving Lab		0	3	1.5
		Total Credits	10	2	10	17

## I Year

# **II Semester**

S.No.	<b>Course Code</b>	Course Title		Т	Р	Credits
1	BSC	Applied Mathematics		1	0	4
2	BSC	Engineering Chemistry	3	1	0	4
3	ESC	Engineering Mechanics	3	1	0	4
4	HSMC	English		0	0	2
5	BSC	Engineering Chemistry Lab		0	3	1.5
6	ESC	Engineering Workshop	1	0	3	2.5
7	HSMC	English Language Communication Skills Lab	0	0	2	1
		Total Credits	12	3	8	19

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

# II YEAR

# I SEMESTER

S.No.	Course Code	Course Title	L	Т	Р	Credits
1	BSC	Engineering Mathematics- III	3	1	0	4
2	PCC	Material and Energy Balance Computations	3	0	0	3
3	PCC	Chemical Engineering Fluid Mechanics	3	1	0	4
4	BSC	Physical and Analytical Chemistry	3	0	0	3
5	PCC	Mechanical Operations		0	0	3
6	PCC	Fluid Mechanics Lab	0	0	2	1
7	BSC	Physical and Analytical Chemistry Lab	0	0	3	1.5
8	PCC	Mechanical Operations Lab	0	0	3	1.5
9	MC	Environmental Science	2	0	0	0
		Total Credits	17	2	8	21

#### **II YEAR**

#### **II SEMESTER**

S.No.	Course Code	Course Title		Т	Р	Credits
1	PCC	Chemical Engineering Thermodynamics-I	3	0	0	3
2	ESC	Basic Electrical Engineering	3	1	0	4
3	HSMC	Management Fundamentals for Engineers	3	0	0	3
4	PCC	Process Heat Transfer		1	0	4
5	BSC	Organic Chemistry		1	0	4
6	ESC	Basic Electrical Engineering Lab		0	2	1
7	BSC	Chemical Technology and Organic Synthesis Lab		0	2	1
8	PCC	Process Heat Transfer Lab	0	0	2	1
		Total Credits	15	3	6	21

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

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

# III YEAR

# I SEMESTER

S.No.	Course Code	Course Title		Т	Р	Credits
1	PE-I	Professional Elective – I	3	0	0	3
2	PCC	Mass Transfer Operations-I	3	1	0	4
3	PCC	Chemical Reaction Engineering-I	3	1	0	4
4	PCC	Instrumentation and Process Control		1	0	4
5	PCC	Chemical Engineering Thermodynamics-II		0	0	3
6	HSMC	Advanced English Communications Skills Lab		0	2	1
7	PCC	Mass Transfer Operations Lab-I	0	0	3	1.5
8	PCC	Instrumentation and Process Control Lab		0	3	1.5
		Total Credits	15	3	8	22

## III YEAR

# **II SEMESTER**

C No	Course	Course Title		т	р	Caradita
S.No. Code		Course Thie		1	r	Creatis
1	OE-I	Open Elective – I	3	0	0	3
2	PE-II	Professional Elective – II	3	0	0	3
3	PCC	Process Modeling and Simulation	3	1	0	4
4	PCC	Mass Transfer Operations-II		1	0	4
5	PCC	Chemical Reaction Engineering-II		1	0	4
6	PCC	Process Simulation Lab	0	0	2	1
7	PCC	Mass Transfer Operations Lab-II	0	0	3	1.5
8	PCC	Chemical Reaction Engineering Lab	0	0	3	1.5
9	MC	Indian Constitution		0	0	0
		Total Credits	17	3	8	22

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

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

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

# IV YEAR

# I SEMESTER

S.No.	Course Code	Course Title	L	Т	Р	Credits
1	OE - II	Open Elective – II	3	0	0	3
2	PE-III	Professional Elective – III	3	0	0	3
3	PE-IV	Professional Elective - IV	3	0	0	3
4	PCC	Chemical Process Technology and Economics	3	0	0	3
5	PCC	Transport Phenomena	3	0	0	3
6		Industry Oriented Mini Project / Industrial Training	0	0	4	2
7		Seminar	0	0	2	1
8	Proj-1	Major Project (Phase-I)	0	0	0	3
		Total Credits	5	0	6	21

## IV YEAR

# **II SEMESTER**

S.No.	Course Code	Course Title		Т	Р	Credits
1	OE - III	Open Elective – III	3	0	0	3
2	PE-V	Professional Elective – V	3	0	0	3
3	PE-VI	Professional Elective – VI	3	0	0	3
4		Major Project (Phase-II)	0	0	0	8
		Total Credits	9	0	0	17

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **Professional Elective – I**

- i) Petroleum Refining and Petrochemicals
- ii) Numerical Methods in Chemical Engineering
- iii) Interfacial and Colloidal Science

## **Professional Elective – II**

- i) Materials Science
- ii) Renewable Energy
- iii) Fluidization Engineering

#### **Professional Elective – III**

- i) Biochemical Engineering
- ii) Corrosion Engineering
- iii) Water Conservation and Management

#### **Professional Elective - IV**

- i) Polymer Science and Engineering
- ii) Computational Fluid Dynamics
- iii) Nuclear Engineering

#### **Professional Elective – V**

- i) Optimization Methods
- ii) Technology of Pharmaceuticals and fine chemicals
- iii) Fuel Cell Technology

## **Professional Elective – VI**

- i) Food Processing Technology
- ii) Membrane Technology
- iii) Process Intensification

## **Open Elective – I**

- i) Solid Waste Management
- ii) Basics of Nanotechnology

## **Open Elective – II**

- i) Industrial Pollution Control Engineering
- ii) Design and Analysis of Experiments

## **Open Elective – III**

- i) Industrial Safety and Hazard Management
- ii) Energy Engineering

## ENGINEERING MATHEMATICS (Linear Algebra and Differential Equations)

I Year B.Tech. I-Sem

L T P C 3 1 0 4

Pre Requisites: Mathematical Knowledge of 12<sup>th</sup>/ intermediate level

## **Course Objectives:**

- 1. Types of matrices and their properties.
- 2. Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- 3. Concept of Eigenvalues and Eigenvectors and to reduce the quadratic form to canonical form
- 4. Methods of solving the differential equations of first and higher order.
- 5. Partial Differentiation, concept of total derivative
- 6. Finding maxima and minima of function of two and three variables.

### **UNIT-I: Matrices**

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

### **UNIT-II: Eigenvalues and Eigenvectors**

Linear Transformation and Orthogonal Transformations, Eigenvalues and Eigenvectors and their properties, Diagonalization of matrices; 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 formsby Orthogonal Transformation.

#### **UNIT-III: 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-IV: Ordinary Differential Equations of Higher Order**

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

## UNIT-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, 36<sup>th</sup> Edition, 2010.
- 2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

#### **Reference Books:**

- 1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- 2. S. L. Ross, Differential Equations, 3<sup>rd</sup> Ed., Wiley India, 1984.

## **Course Outcomes:**

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

- 1. Write the matrix representation of a set of linear equations and to analyze the solution of the system of equations
- 2. Find the Eigenvalues and Eigenvectors
- 3. Reduce the quadratic form to canonical form using orthogonal transformations.
- 4. Identify whether the given differential equation of first order is exact or not
- 5. Solve higher differential equation and apply the concept of differential equation to real world problems
- 6. Find the extreme values of functions of two variables with/ without constraints.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

### **ENGINEERING PHYSICS**

I Year B.Tech. I-Sem

L T P C 3 10 4

**Prerequisites** : Nil Course Objectives :

The course should enable the students to:

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

## **UNIT-I: Wave Optics**

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

## **UNIT-II: Lasers and Fibre Optics**

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

**Fibre Optics:**Introduction, Principle and Construction of an optical fibre, Acceptance angle, Numerical aperture, Types of Fibres-Single & Multimode, Glass & Plastic, Step Index & Graded Index Optical fibers, Losses associated with optical fibres, Basic components in optical fiber communication system, Applications of optical fibres.

## **UNIT-III: Introduction to solids**

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

## **UNIT-IV: Synthesis & Characterization of Nanomaterials**

Introduction, nanoscale, Quantum confinement, Surface to volume ratio, Bottom-up Fabrication: Sol-Gel, Precipitation, Combustion Methods; Top-Down Fabrication: Chemical Vapor Deposition, Physical Vapor Deposition, Characterization Techniques (XRD, SEM &TEM) and Applications of nanomaterials. Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# **UNIT-V: Ultrasonics & Acoustics of Buildings**

**Ultrasonics:**Introduction, Production of ultrasonic waves, Magneto striction method, Piezo electric method, Detection of ultrasonic waves, Properties of ultrasonic waves, Use of ultrasonics for non-destructive testing, Applications of ultrasonics.

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

# **Text Books:**

1. A textbook of Engineering Physics, Dr. M.N. Avadhanulu, Dr. P.G Kshirsagar - S.Chand

2. Haliday and Resnick, Physics - Wiley

# **References:**

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

# **Course Outcomes:**

The student will able to:

- 1. Analyze and get knowledge about diffraction grating and polarization.
- 2. Justify applications and principles of laser and how the graded index optical fiber is more efficient than step index optical fiber in fiber optic communication system.
- 3. Gain clear knowledge about Fermi level and energy band diagram.
- 4. Get clear knowledge about fabrication and characterization of nanomaterials.
- 5. Learn about Principles and applications of ultrasonic waves and acoustics of buildings.

#### **PROGRAMMING FOR PROBLEM SOLVING**

#### I Year B.Tech. I-Sem

L T P C 3 0 0 3

# Pre Requisites: Nil

# **Course Objectives:**

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

## UNIT – I

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

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

# UNIT – II

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

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

## UNIT – III

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

## UNIT – IV

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

**Input and Output:** Concept of a file, streams, standard input / output functions, formatted input / output functions, text files and binary files, file input / output operations, file status functions (error handling), C program examples.

## UNIT – V

**Derived types:** Structures – Declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bit fields, enumerated types, C programming examples.

SortingandSearching: Selection sort, Bubble sort, Insertion sort, Linear search and Binary search methods.

# **Text Books:**

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

#### **Reference Books:**

- 1. C for Engineers and Scientists byH.Cheng, Mc.Graw-Hill International Edition
- 2. Data Structures using C by A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education, PHI
- 3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

## **Course Outcomes:**

The student will learn

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

### **ENGINEERING GRAPHICS**

## I Year B.Tech. I-Sem

Pre Requisites: Nil

## **Course Objectives:**

1. To provide basic concepts in engineering drawing

2. To impart knowledge about standard principles of orthographic projection of objects

3. To draw sectional views and pictorial views of solids

# UNIT-I

# INTRODUCTION TO ENGINEERING DRAWING:

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

# UNIT-II

# **ORTHOGRAPHIC PROJECTIONS:**

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

# UNIT-III

Projections of Regular Solids – Auxiliary Views.

## UNIT-IV

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

# UNIT-V

## **ISOMETRIC PROJECTIONS:**

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

## **Text Books:**

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

# **Reference Books**:

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

L T P C 1 0 4 3

## **Course Outcomes:**

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

- 1. Prepare working drawings to communicate the ideas and information.
- 2. Read, understand and interpret engineering drawings.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

### ENGINEERING PHYSICS LAB

## I Year B.Tech. I-Sem

L	Т	Р	С
0	0	3	1.5

# Pre Requisites: Nil

## **Course Objectives:**

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

# List of Experiments:

- 1. Melde's experiment: To determine the frequency of a vibrating bar or turning fork usingMelde'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:Todetermine the spring constant by single coupled oscillator.
- 7. LCR Circuit:Todetermine 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.
- 11. Sonometer: To determine the AC frequency.
- 12. Stewart Gee's experiment: Determination of magnetic field along the axis of a current carrying coil

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

## **Course Outcomes:**

By the end of the course students will be able:

- 1. To make careful experimental observations and draw conclusions from such data.
- 2. To distinguish between inferences based on theory and the outcomes of experiments.
- 3. To write a technical report which communicates scientific information in a clear and concise manner.

## PROGRAMMING FOR PROBLEM SOLVING LAB

## I Year B.Tech. I-Sem

L T P C 0 0 3 1.5

# Pre Requisites: NIL

## **Course Objectives:**

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

# Week 1:

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

# Week 2:

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

# Week 3:

9. Write a C program to find both the largest and smallest number in a list of integers.

10.Write a C program that uses functions to perform the following:

- i) Addition of Two Matrices
- ii) Multiplication of Two Matrices

## Week 4:

11. Write a C program that uses functions to perform the following operations:

- i) To insert a sub-string in to a given main string from a given position.
- ii) To delete n Characters from a given position in a given string.
- 12. Write a C program to determine if the given string is a palindrome or not
- 13.Write a C program that displays the position or index in the string S where the string T begins, or 1 if S doesn't contain T.
- 14.Write a C program to count the lines, words and characters in a given text.

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 15. Write a C program to generate Pascal's triangle.
- 16.Write a C program to construct a pyramid of numbers.
- 17. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression:  $1+x+x^2+x^3+....+x^n$

For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Print x, n, the sumPerform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.

# Week 6:

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

# Week 7:

20. Write a C program that uses functions to perform the following operations:

- i) Reading a complex number
- ii) Writing a complex number
- iii) Addition of two complex numbers
- iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

## Week 8:

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

## Week 9:

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

## Week 10:

24. Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers:

i) Linear search ii) Binary search

### Dept. of CHEM./JNTUHCEH B.Tech.(Reg), v

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# **Text Books:**

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

## **Reference Books:**

- 1. C for Engineers and Scientists byH.Cheng, Mc.Graw-Hill International Edition
- 2. Data Structures using C by A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education, PHI
- 3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

# **Course Outcomes**

The student will learn

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

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# APPLIED MATHEMATICS (Transforms and Vector Calculus)

I Year B.Tech. II-Sem

L T P C 3 1 0 4

**Pre Requisites**: Mathematical Knowledge of 12<sup>th</sup>/ Intermediate level

Course Objectives: To learn1. Concept, properties of Laplace transforms

- 2. Solving ordinary differential equations using Laplace transforms techniques.
- 3. Expressing periodic function by Fourier series and a non-periodic function by Fourier transforms
- 4. Basic concept of PDE and solutions of PDE by Fourier Transforms
- 5. Some physical problems in Engineering that results in PDE and their solutions
- 6. The physical quantities involved in engineering field related to vector valued functions
- 7. The basic properties of vector valued functions and their applications to line, surface and volume integrals

## UNIT-I: Laplace transforms

Laplace Transforms; Laplace Transform of standard functions; first shifting theorem; Laplace transforms of functions when they are multiplied and divided by't'. Laplace transforms of derivatives and integrals of function; Evaluation of integrals by Laplace transforms; Laplace transforms of Special functions; Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem (without proof), solving ODEs by Laplace Transform method.

## **UNIT-II: Fourier series & Fourier transforms**

Fourier series, Dirchelet's Conditions, Half-range Fourier series. Fourier Transforms, Fourier Sine and cosine transforms, Inverse Fourier transforms.

## **UNIT-III: Partial Differential Equations**

Partial differential Equations of Second Order, Classifications, Solution of PDE using separation of variables, One dimensional wave equation and Heat equation and their solutions.

## **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.

## **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, 36<sup>th</sup> Edition, 2010.
- 2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

#### **Reference Books:**

- 1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11<sup>th</sup>Reprint, 2010.
- 2. Dr. Manish Goyal, N.P. Bali, Transforms and Partial Differential Equations, Second Edition, Laxmi Publications Pvt ltd

## **Course Outcomes:**

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

- 1. Use the Laplace transforms techniques for solving ODE's
- 2. Express any periodic function in term of sines and cosines
- 3. Express a non-periodic function as integral representation
- 4. Classify PDE and solve PDE by separation of variables.
- 5. Solve One dimensional wave equation and Heat equation
- 6. Evaluate the line, surface and volume integrals and converting them from one to another

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **ENGINEERING CHEMISTRY**

# I Year B.Tech. II-Sem

L T P C 3 1 0 4

# **Course Objectives:**

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

# UNIT-1: Molecular structure and Theories of Bonding:

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N2, O2 and NO molecules. Bond order.

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

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

## UNIT-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 ozonisation. 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 coating- Hot dipping, cementation – methods of application. Electroless plating and Electroless plating of Copper.

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# 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  $S_N 1$ ,  $S_N 2$  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<sub>4</sub> and chromic acid.

Reduction reactions: reduction of carbonyl compounds using LiAlH<sub>4</sub>& NaBH<sub>4</sub>. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

# UNIT-V: Spectroscopic techniques and applications:

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

# **Text Books:**

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

# **Reference Books:**

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

# **Course Outcomes:**

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

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

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

I Year B.Tech. II-Sem

L T P C 3 1 0 4

# Pre Requisites: Nil

# **Course Objectives:**

During this course, students should develop the ability to:

1. Work comfortably with basic engineering mechanics concepts required for analyzing staticstructures

**ENGINEERING MECHANICS** 

- 2. Identifyanappropriatestructural system tostudyingagivenproblem and isolate it from itsenvironment.
- 3. Model the problem using good free-body diagrams and accurate equilibrium equations
- 4. Identify and model various types of loading and support conditions that act on structural systems.
- 5. Apply pertinate mathematical, physical and engineering mechanical principles to the system to solve and analyze theproblem.
- 6. Understand the meaning of centers of gravity (mass)/centroids and moments of Inertia using integrationmethods.
- 7. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.

# **UNIT – I: INTRODUCTION OF ENGINEERING MECHANICS**

Basic concepts SystemofForces – CoplanarForces–ComponentsinSpace–Resultant- Moment of Forces and its Application – Couples and Resultant of Force System-EquilibriumofSystemofForces-Freebodydiagrams-Direction of Force Equations of Equilibrium of Coplanar Systems and Spatial Systems – Vector cross product- Support reactions different beams for different types of loading – concentrated, uniformly distributed and uniformly varying loading.

## **UNIT – II: FRICTION**

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

## **UNIT – III: CENTROID AND CENTER OF GRAVITY**

Centrods – Theorem of Pappus- Centroids of Composite figures – Centre of Gravity of Bodies – AreamomentofInertia: – polarMomentofInertia–Transfer–Theorems - Moments of Inertia of Composite Figures.

**MOMENT OF INERTIA:** Moment of Inertia of Areas and Masses – TransferFormulaforMomentsofInertia-Momentofinertiaofcomposite areas andmasses.

## **UNIT – IV: KINEMATICS**

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

**UNIT - V: KINETICS** 

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

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

# **Text Books:**

- 1. EngineeringMechanicsbyshames&Rao-PearsonEducation.
- 2. Engineering Mechanics by M.V. Seshagiri rao and Durgaih; UniversityPress.
- 3. Engineering Mechanics B. Bhattacharya Oxford University Publications.

# **References Books:**

- 1. Engineering Mechanics (Statics and Dynamics) by Hibbler; Pearson Education.
- 2. Engineering Mechanics by Fedrinand L. Singer Harper Collings Publishers.
- 3. EngineeringMechanicsbyA.K.Tayal,UmeshPublication.
- 4. EngineeringMechanics-G.S.Sawhney,PrinticeHallofIndia.
- 5. A text book of engineering mechanics by R. K. Bansal; Laxmi publications.
- 6. EngineeringMechanicsbyR.S.Khurmi;S.Chand&Co.

# **Course Outcomes:**

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

- 1. Solve problems dealing with forces in a plane or in space and equivalent forceSystems.
- 2. Solve beam and cable problems and understand distributed force systems.
- 3. Solve friction problems and determine moments of Inertia and centroid using integrationmethods.
- 4. Understand and know how to solve three-dimension force and momentproblems.
- 5. Understandandknowhowtousevectorterminology.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### ENGLISH

## I Year B.Tech. 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 for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development in the areas of Vocabulary, Grammar, Reading and Writing Skills, fostering ideas and practice of language skills in various contexts.* 

## **LEARNING OBJECTIVES**

The course will help students to

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

#### **SYLLABUS**

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

### UNIT-I

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

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

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

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

# UNIT-II

Vocabulary: Synonyms and Antonyms.

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

Reading: Improving Comprehension Skills – Techniques for Good Comprehension.

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

### Unit –III

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.
Reading: Sub-skills of Reading- Skimming and Scanning
Writing: Writing Introduction and Conclusion - Essay Writing.

### Unit –IV

Vocabulary: Standard Abbreviations in EnglishGrammar: Redundancies and ClichésinOral and Written Communication.Reading: Comprehension- Intensive Reading and Extensive Reading.Writing: Writing Practices---Précis Writing.

Unit –V

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction - Characteristics of a Report - Categories of ReportsFormats-

Structure of Reports (Manuscript Format) - Types of Reports - Writing aReport.

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

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

#### **ReferencesBooks:**

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

#### **Course Outcomes:**

Students should be able to

- 1. Use English Language effectively in spoken and written forms.
- 2. Comprehend the given texts and respond appropriately.
- 3. Communicate confidently in various contexts and different cultures.
- 4. The student will acquire basic proficiency in English including reading and listening comprehension, writing, and speaking skills

#### ENGINEERING CHEMISTRY LAB

## I Year B.Tech. II-Sem

L T P C 0 0 3 1.5

# **Course Objectives:**

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

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

# List of Experiments

- 1. Determination of total hardness of water by complexometric method using EDTA
- 2. 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<sub>4</sub>
- 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<sub>f</sub> values. egortho 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.

## **References 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<sup>th</sup> edition Text book on Experiments and calculations in Engineering

## **Course Outcomes:**

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

- 1. Determination of parameters like hardness and chloride content in water.
- 2. Estimation of rate constant of a reaction from concentration time relationships.
- 3. Determination of physical properties like adsorption and viscosity.
- 4. Calculation of R<sub>f</sub> values of some organic molecules by TLC technique.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## ENGINEERING WORKSHOP

I Year B.Tech. II-Sem

L T P C 1 0 3 2.5

Pre-requisites: Practical skill

# **Course Objectives:**

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

# I. TRADES FOR EXERCISES:

(Any six trades from the following with minimum of two exercises in each trade)

- 1. Carpentry 2 Lectures
- 2. Fitting-1Lecture
- 3. Tin-Smithy- 1Lecture
- 4. Black Smithy-1Lecture
- 5. House-wiring-1Lecture
- 6. Foundry- 2 Lectures
- 7. Plumbing-1Lecture
- II. Trades for Demonstration & Exposure
  - 1. Demonstration of power tools -1 Lecture
  - 2. Welding 2 Lecture
  - 3. Machine Shop -2 Lectures
- III. **IT Workshop I:** Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, simple diagnostic exercises.

IT Workshop II: Installation of operating system windows and linux simple diagnostic exercises.

# **Text Books:**

- 1. Workshop Practice by B.L.Juneja Cengage Learning
- 2. Elements of Workshop Technology–S. K.Hajra Choudhury and A. K. Hajra Choudhury.

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# **Course Outcomes:**

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

- 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.

# ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

# I Year B.Tech. II-Sem

L	Т	Р	С	
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

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 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 syllabusis 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: BasicRules 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

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# CALL Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests.

# ICS Lab:

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

# Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

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

# System Requirement (Hardware component):

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

- i) Computers with Suitable Configuration
- ii) High Fidelity Headphones
- 2. Interactive Communication Skills (ICS) Lab:

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

\*\*\*\*\*

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# **ENGINEERING MATHEMATICS – III**

### (Probability Distributions and Complex Variables)

II Year B.Tech. I-Sem

LTPC

3 1 0 4

Pre Requisites: Mathematics courses of first year of study.

# Course Objectives: To learn

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

# **UNIT-I: Basic Probability**

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

# **UNIT-II: Probability distributions**

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

# **UNIT-III: Estimation & Tests of Hypotheses**

Introduction, Statistical Inference, Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.

Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Tests Concerning a Single Mean, Tests on Two Means, Test on a Single Proportion, Two Samples: Tests on Two Proportions.

# **UNIT-IV: Complex Variables (Differentiation)**

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

# **UNIT-V: Complex Variables (Integration)**

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

**Text Books** 

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 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, 9<sup>th</sup> Edition, Pearson Publications.
- 3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

#### **Reference Books:**

- 1. Fundamentals of Mathematical Statistics, Khanna Publications, S C Guptha and V.K. Kapoor.
- 2. Miller and Freund's, Probability and Statistics for Engineers, 8<sup>th</sup> 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, LaxmiPublications, Reprint, 2010.

## **Course outcomes:**

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

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

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

LTPC

3 0 0 3

# MATERIAL AND ENERGY BALANCE COMPUTATIONS

II Year B.Tech. I-Sem

# Pre Requisites: NIL

# **Course Objectives:**

1. To describe the fundamentals of stoichiometric relations to calculate composition of different mixtures and solutions.

- 2. To solve problems on mass balance, using, different gas laws, vapor pressure laws and humidity concept and psychometric charts
- 3. To demonstrate enthalpy balance concept needed for solution of energy balance of different chemical engineering processes in industries.

# UNIT- I

**Stoichiometric & Composition relations**: Stoichiometric relation, basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

# UNIT- II

**Vapor pressure**: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Nonvolatile solutes.

**Humidity and Saturation**: Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization.

# UNIT- III

**Material balances**: Tie substance, Yield, conversion, limiting reactant, excess reactant, processes involving reactions, Material balances with the help of Stoichiometric equations, Material balances involving drying, dissolution, & crystallization. Material balance calculations for processes involving recycle, bypass and purge.

# UNIT- IV

**Thermo physics**: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

**Thermo chemistry**: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchhoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

# UNIT- V

**Combustion Calculations**: Introduction, fuels, calorific value of fuels, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations

**Text Books:**
B.Tech.(Reg), w.e.f. 2019-20 Academic Year

 Chemical process principles, Part -I, Material and Energy Balance, Hougen O A, Watson K.M. and Ragatz R.A. 2<sup>nd</sup> Edition, John Wiley and Sons, New York, 1963.

# **Reference Books:**

- 1. Basic principles and calculations in chemical engineering by D.H. Himmelblau, 7th Ed. PHI, 2013
- Stoichiometry by B.I. Bhatt and S.M. Vora (3<sup>rd</sup> Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

# **Course Outcomes:**

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

- 1. Apply basic principles of stoichiometry and material balance on unit operations and processes
- 2. Identify equations of state and properties of gases and liquids, including phase transition
- 3. Evaluate humidity with / without the use of psychometric chart.

4. Demonstrate

elementaryflow-

sheeting, material and energy balance calculations without and with chemical reactions, and involving concepts likerecycle, by pass and purge.

5. Developmasteryoverprocesscalculationsrelevanttochemicalengineeringprocesses

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# CHEMICAL ENGINEERING FLUID MECHANICS

#### II Year B.Tech. I-Sem

#### L T P C 3104

**Pre Requisites**: Basic of Hydrostatics and Hydrodynamics-Mechanics of Fluid flow **Course Objectives:** 

- 1. To apply themechanicsoffluids(fluidstaticsandfluid dynamics), relevanttoChemicalEngineeringoperations.
- 2. To identify forces onfluids, hydrostaticforcesonsubmerged bodiesinvolvingmass andmomentumbalances, Bernoulliequation,flow throughpipesandducts, flowmeasurementandinstruments,flowtransportationpumps,blowersandcompressors, conservation ofmass, viscousflows,skinandformfriction,lubricationapproximation,potentialflows andboundarylayertheory.
- 3. To calculate fluid flow, pump power, head loss due to friction and to design the fluid machinery.

#### UNIT- I

Unit operations and unit processes, unit systems, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

**Fluidflowphenomena**-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers, Basic equation of fluid flow –Mass balance in a flowing fluid; continuity equation, differential momentum balance; equations of motion, Macroscopic momentum balances, Bernoulli equation, pump work in Bernoulli equation.

#### UNIT- II

**Incompressible Flow in pipes and channels**- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction, Dimensional analysis including Buckingham  $\pi$  Theorem and Rayleigh's method.

#### UNIT- III

**Flow of compressible fluids-** Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

#### UNIT- IV

**Flow past immersed bodies**, Drag and Drag coefficient, friction in flow through beds of solids, Kozeny-Carman, Blake-Plummer and Ergun equations, and motion of particles through fluids.Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized beds, Applications of fluidization. Continuous fluidization; slurry and pneumatic transport.

#### UNIT- V

**Transportation and Metering of fluids**- Pipes, fittings and valves, Fluid-moving machinery, Fans, blowers, and compressors.Measurement of flowing fluids- variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meters- Rotameter.

Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations

#### **Text Books:**

- 1. Unit Operations of Chemical Engineering by W.L.Mc-Cabe, J.C.Smith& Peter Harriot, McGraw-Hill, 7<sup>th</sup>ed, 2007
- 2. Chemical Engineering Fluid Mechanics by Ron Darby, CRC Press, 2<sup>nd</sup> Edn, 2001

#### **Reference Books:**

- 1. Transport processes and unit operations by Christie J. Geankoplis, PHI
- 2. Unit operations, Vol-1 Chattopadhya, Khanna publishers
- 3. Principles of Unit Operations, Foust et al, 2<sup>nd</sup> ed., John Wiley, 1999
- 4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

#### **CourseOutcomes:**

- 1. Illustrate bysimplificationofequationsofmotioninsimple1-Dflows
- 2. Calculate Boundary layerthicknesses, friction factor, pressure drop
- 3. Explain about the compressible fluid flow
- 4. Design fluidized and packed beds.
- 5. Select pump based on their performance and flow measurement by various meters.

#### B.Tech.(Reg), w.e.f. 2019-20 Academic Year PHYSICAL AND ANALYTICAL CHEMISTRY

II Year B.Tech. I-Sem

L T P C 3 0 0 3

# Pre Requisites: NIL

#### **Course Objectives:**

1) To understand the basic Principles of analytical methods and detailed methods of U.V. visible, Mass Spectrometry which are required for B.Tech chemical Engineering students to analyze the Chemical compounds.

2) The chromatographic techniques and the knowledge of colloids and adsorption are required for further understanding and analysis.

#### UNIT- I

**Chemical Kinetics**: Order, molecularity– definitions with examples. Introduction to first order, second order, third order Kinetics-Theories of Reaction rates – Collision theory and transition state theory. Theory of unimolecular reactions – Lindemann'sTheory-Kinetics of Photochemical reactions: Chain reactions and their characteristics. Steady state treatment – dissociation of HI, reaction between  $H_2$ &  $Br_2$  and  $H_2$ & $Cl_2$ .

#### UNIT- II

**Colloids & Surface chemistry:** Colloids: Classification - Preparation and purification of colloids, properties of colloids – electrical properties, zeta potential and its measurement-Stability of colloids- protective action of colloids – gold number and factors affecting their stability. Applications of colloids. Surface Chemistry: adsorption, physisorption and chemisorptions, factors influencing adsorption-Adsorption isotherms – Freundlich, Langmuir, B.E.T theory of adsorption. Determination of surface area using B.E.T method. Applications of adsorption.

#### UNIT- III

**Chromatography:**Principle-Types of adsorption-Column chromatography-retention time, retention volume, RF value. Thinlayer chromatography-identification of spots by spraying and other methods; Gas Chromatography: Principle-block diagram of gas chromatograph, functions of each component, detectors- (FID, ECD)-Applications-Qualitative analysis, quantitative analysis, retention time, retention volume, capacity factor, area normalization method; HPLC: Principle, block diagram- functions of each component, stationary phases, eluting solvents, pumps, detectors- quantitative applications of HPLC.

#### UNIT-IV

# Molecular Spectroscopy:

Instrumentation, block diagrams of UV-visible and IR Spectrophotometers. Basic principles of Mass Spectroscopy, Fragmentation, Nitrogen rule, Mc-battery rearrangement: Applications of Mass Spectroscopy.

#### Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### Gravimetric and Thermal Analysis:

Quantitative analysis - Gravimetry: Precipitation- types of precipitates, impurities, co-precipitation, postprecipitation-conditions for participation-precipitation from homogeneous solution-Gravimetric determination of Ni and Cu.

Thermal methods of Analysis:Introduction,Therrmo Gravimetry Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning calorimetry(DSC).

#### **Text Books:**

1. Quantitative analysis, R.A. Day & A.L. Underwood Prentice-Hall of India, Pvt. Ltd.

2. Vogel's Text book of Quantitative chemical analysis, J.Mendham, R.C Denny, J.D. Barnes,

M J.K.Thomas, pearson education

#### **Reference Books:**

1. Elements of Physical Chemistry - Peter Atkins, Oxford Uni Press

2. Advanced Physical Chemistry – Gurudeep Raj, Goel Publishing house

3. Instrumental Methods of Chemical Analysis, BSP Galen W. Ewing.

4. Essentials of Physical Chemistry - Bahl, Tuli and ArunBahl, S.Chand and Company Ltd.,

#### **Course Outcomes:**

- 1. The student will gain a thorough knowledge of GC & HPLC techniques and spectroscopic Principles.
- 2. The Principles of Kinetics, adsorption colloidal Chemistry are clearly understood.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year MECHANICAL OPERATIONS

II Year B.Tech. I-Sem

L T P C 3 0 0 3

# **Pre Requisites**: NIL **CourseObjectives**:

describe

thenumerous industrial operations dealing with the particulates olids, their handling invarious unit operations, and the sein which particle-fluid interactions are important.

- 2. To explain fluid-particlemechanics, suchasthenotionofdrag,andbuildsonthosefundamentalstodevelopdesignconceptsforvarious industrialprocesseslike packed bed operation, fluidized operations, sedimentation,filtration,separationofsolidsandfluids,etc.Industrialapplicationsarediscussed.
- 3. To explain the methods of separations based on motion of a particle through fluids.
- 4. To describe the working of size reduction equipment's

# UNIT- I

1. To

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate mass, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids. Transportation of solid particulate mass, belt, screw, apron conveyers, bucket elevators, pneumatic conveying.

# UNIT- II

**Size reduction:** Principles of comminution, computer simulation of milling operations, size reduction equipment-crushers, grinders, ultra-fine grinders, cutting machines, Equipment operation. Laws of crushing: Kick's law, Bond's law, Rittinger'slaw.Screening, Industrial screening equipments, Effectiveness of the screen, differential & cumulative analysis.

# UNIT- III

Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes, float and sink method, differential settling, design of thickeners, coagulation, cyclone separator, electro-static precipitators.

# UNIT- IV

Filtration, cake filters, centrifugal filters, principles of cake filtration. Clarifying filters, liquid clarification, gas cleaning, and principles of clarification.

# UNIT- V

**Special separations:**Membrane separations, types of membranes, cross flow filtration, permeate flux for ultrafiltration, concentration polarization, particle rejection of solutes, micro filtration,electrostaticseparation,magnetic separator, flotation and flotation agents.

# **Text Book:**

1. Unit Operations in Chemical Engineering by W.L. McCabe and J.C. Smith and Peter Harriott, Mc.Graw Hill 7<sup>th</sup>edn. 2001.

# **Reference Books:**

#### Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 1. Chemical engineers hand book, J.H. Perry, 7<sup>th</sup> ed. Mc-Graw Hill
- 2. Introduction to Chemical Engineering by J.T. Banchero& W.L Badger, TMH, 1997.

#### **CourseOutcomes:**

- 1. State the significance and usage of different particulate characterization parameters and equipment to estimate them
- 2. Describe size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment.
- 3. Calculate the drag force and terminal settling velocity for single particles.
- 4. Calculatepressuredropinfixedandfluidizedbeds
- 5. Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year FLUID MECHANICS LAB

#### II Year B.Tech. I-Sem

LTPC

0 0 2 1

**Pre Requisites:** Chemical Engineering Fluid Mechanics **CourseObjectives:** 

- 1. Verify Bernoulli's equation using Bernoulli's apparatus.
- 2. Analyze and compare orifice and venturi coefficients.
- 3. Test the characteristics of centrifugal pump.

#### List of Experiments

- 1. Identification of laminar and turbulent flows
- 2. Measurement of point velocities
- 3. Verification of Bernoulli's equation
- 4. Calibration of Rotameter
- 5. Variation of Orifice coefficient with Reynolds Number
- 6. Determination of Venturi coefficient
- 7. Friction losses in Fluid flow in pipes
- 8. Pressure drop in a packed bed for different fluid velocities
- 9. Pressure drop and void fraction in a fluidized bed
- 10. Studying the coefficient of contraction for a given open orifice
- 11. Studying the coefficient of discharge in a V-notch
- 12. Studying the Characteristics of a centrifugal pump

#### **CourseOutcomes:**

- 1. Understand the concept of fluid flow phenomena and the types of flow by calculating Reynolds Number.
- 2. Calibrate the flow meters with actual discharge, characterize the centrifugal pump and its efficiency
- 3. Calculate the coefficient of contraction in an orifice and venturimeters.
- 4. Calculate the pressure drop in packed bed for different velocities.
- 5. Calculate the discharge coefficient in notches.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### PHYSICAL AND ANALYTICAL CHEMISTRY LAB L T P C

#### II Year B.Tech. I-Sem

# 0 0 3 1.5

Pre Requisites: Physical and Analytical Chemistry

# **Course Objectives:**

- 1. To determine the partition coefficient using adsorption technique.
- 2. To describe the chemical kinetics for a given reaction.
- 3. To analyse given sample using various chromatographic and spectroscopic techniques.

# List of Experiments:

- 1. Verification of Freundlich adsorption-adsorption of acetic acid on animal charcoal.
- 2. Determination of rate constant of reaction between  $K_2S_2O_8$  and KI.
- 3. Complex preparations: a)  $[Ni(DMG)_2]$  b)  $[Co(NH_3)4Cl] Cl_2$  c)  $[Cu(NH_3)_4] SO_4$
- 4. Estimation of iron in cement using Spectrophotometer.
- 5. Thin layer chromatography: a) Determination of the purity (No. Of compounds present) of a given sample by thin layer chromatography (TLC). b) Monitoring the progress of chemical reactions of thin layer chromatography(TLC).
- 6. Estimation of Dissolved oxygen in water.
- 7. Determination of stability constant by Job's method Cu EDTA Complex.
- 8. Determination of sulphates through turbidometry.
- 9. Assay of Ibuprofen.
- 10. Redox titrations by Potentiometry. Estimation of Ferrous iron.

# **Suggested Books:**

- 1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition- J.Mendham et al, Pearson Education.
- 2. Practical Manual of Analytical Chemistry- Neelam, Singh, Navneet Kaur and Kanchan kohli.

# **Course Outcomes:**

- 1. Apply adsorption technique to estimate the partition coefficient value.
- 2. Study the chemical kinetics and interpret the order from the given chemical reaction.
- 3. Apply spectroscopic and thin layer chromatographic techniques by determining the purity and observing the progress of given sample.
- 4. Estimate the amount of dissolved oxygen and sulphates in water.
- 5. Perform redox titrations by using potentiometric technique.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

#### B.Tech.(Reg), w.e.f. 2019-20 Academic Year MECHANICAL OPERATIONS LAB

#### II Year B.Tech. I-Sem

L T P C 0 0 3 1.5

Pre Requisites: Mechanical Operations

#### **Course Objectives:**

- 1. Estimate the average size of the particles in a given feed and verify the various crushing laws using size reduction equipment with various mesh screens.
- 2. Calculate thethickener area using batch sedimentation data.
- 3. Calculate the reduction ratio of a given sample in a grinder.

# List of Experiments

- 1. Sampling of an ore from the bulk by
  - (i) Coning and quartering method.(ii) Riffle sampler.
- 2. Determination of average particle size of a given material by sieve analysis.
- 3. Determine the average particle size of a given sample by optimum sieve analysis
- 4. Verification of Stoke's Law.
- 5. Size reduction of the given material using Jaw Crusher and determine the reduction ratio.
- 6. Size reduction of the given material using Roll Crusher and verification of comminution laws.
- 7. Size reduction of the given material using Ball Mill and determine the reduction ratio.
- 8. Calculate the thickener area from the batch sedimentation process under the given conditions.
- 9. Determine the specific cake resistance and filter medium resistance of a slurry in plate and

frame filter press.

- 10. Calculate the separation efficiency of particles in a mixture using cyclone separator.
- 11. Determination of recovery percentage of the concentrate by Froth-Floatation process.

# **CourseOutcomes:**

- 1. Pick or take a representative amount of sample and conduct sieve analysis.
- 2. Determine the reduction ratio in crushing and grinding of different materials using various size reduction units.
- 3. Evaluate the recovery percentage from froth flotation unit and thickener area.
- 4. Interpret the data and prepare formal lab reports describing the obtained experimental results.
- 5. Calculate power consumption of crushers by using laws

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year ENVIRONMENTAL SCIENCE

II Year B.Tech. I-Sem

L T P C 2 0 0 0

#### Pre-Requisites: NIL

#### **Course Objectives:**

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

#### UNIT-I:

#### MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:

Definition, Scope and Importance - Need for Public Awareness.

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

#### UNIT-II:

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

#### UNIT-III:

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

#### UNIT-IV:

#### **Environmental Pollution and control:**

**Environmental Pollution:** Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards.

Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution:

Sources and types, Impacts of modern agriculture, degradation of soil.

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

#### UNIT-V:

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. —Consumerism and waste products. -Environment Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness.

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

#### **Text Books:**

- 1. Textbook of Environmental Studies for Undergraduate Courses by ErachBharucha for University Grants Commission., Universities Press.
- 2. Environmental Studies by R. Rajagopalan, Oxford University Press.

#### **Reference Books:**

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

#### **Course Outcomes:**

At the end of the course, it is expected that students will be able to:

- 1. Identify and analyze environmental problems as well as the risks associated with these problems
- 2. Understand what it is to be a steward in the environment
- 3. Studying how to live their lives in a more sustainable manner

# CEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year CHEMICAL ENGINEERING THERMODYNAMICS-I

#### II Year B.Tech. II-Semester

LTPC

3 0 0 3

#### Pre Requisites: NIL

# CourseObjectives:

- 1. To provide the knowledge on basics of thermodynamics like system, properties, processes, reversibility, equilibrium, phases, components; the relationship between heat and work.
- 2. To learn in details the laws of thermodynamics and their applications; thermodynamic relations
- 3. To learn the basics of sensible latent heat effects of industrial processes

# UNIT- I

**Introduction**: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiment.

The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant-V and constant-P processes, heat capacity, isobaric, isochoric, isothermal, adiabatic and polytrophic processes.

#### UNIT- II

**Volumetric properties of pure fluids:** The PVT behavior of pure substances, Virial equations, the ideal gas, the applications of the Virial equations, second Virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

# UNIT-III

The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale, Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point, calculation of ideal work and lost work.

# UNIT-IV

**Heat effects**: Sensible heat effects, Latent heats of pure substances, heat effects of industrial reactions, heat effects of mixing processes. Standard heat of reaction, Standard heat of formation, Standard heat of combustion, temperature dependence of heat of reaction

Power cycles: Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle.

# UNIT- V

**Refrigeration and liquefaction:** The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.

**Thermodynamic properties of fluids:** Property relations for homogeneous phases, Maxwell relations, residual properties, two phase systems, thermodynamic diagrams, generalized property correlation for gases. Turbines, Throttling process, compression process.

#### **Text Books:**

- 1. J.M.Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 7<sup>th</sup>ed, McGraw Hill,2005.
- 2. Chemical Engineering Thermodynamicsby B.F Dodge Mc Graw-Hill Book. Co.

#### **Reference Books:**

- 1. Y.V.C.Rao, Chemical Engineering Thermodynamics, University publications.
- 2. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI, 2001.

#### **CourseOutcomes:**

- 1. Apply fundamental concepts of thermodynamics to engineering applications
- 2. Estimate thermodynamic properties of substances in gas and liquid states
- 3. Apply mass, energy and entropy balances to flow processes.
- 4. Describe about various power cycles.
- 5. Understand the thermodynamic properties of fluids.

#### B.Tech.(Reg), w.e.f. 2019-20 Academic Year BASIC ELECTRICALENGINEERING

#### II Year B.Tech. II-Sem

L T P C 3 1 0 4

# Pre- Requisites: Nil

# **Course Objectives:**

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

# UNIT-I

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

#### UNIT-II

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit.

Three-phase balanced circuits, voltage and current relations in star and delta connections.

# UNIT-III

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

# UNIT-IV

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

#### UNIT-V

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

#### **Text Books:**

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

# **Reference Books:**

- 1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
- 2. J B Gupta "Electrical Installation Estimating and Costing" S. K. Kataria & Sons, 2009.

#### Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
- 4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
- 5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

# **Course Outcomes:**

- 1. To analyze and solve electrical circuits using network laws and theorems.
- 2. To understand and analyze basic Electric and Magnetic circuits.
- 3. To study the working principles of Electrical Machines.
- 4. To introduce components of Low Voltage Electrical Installations.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# MANAGEMENT FUNDAMENTALS FOR ENGINEERS

#### II Year B.Tech. II-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.

#### Unit- I

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

#### Unit-II

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

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

#### Unit –III

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

# Unit-IV

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

# Unit-V

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

#### **Suggested Readings:**

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

#### **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.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### PROCESS HEAT TRANSFER

II Year B.Tech. II-Sem

L T P C 3 1 0 4

Pre Requisites: Chemical Engineering Fluid Mechanics

# CourseObjectives:

- 1. To differentiate various modes of heat transfer
- 2. To formulate the equations for calculating heat flux for conduction, convection, radiation, boiling, condensation
- 3. To develop the governing equations for designing and analyzing heat transfer equipment

#### UNIT- I

Introduction: Nature of heat flow, conduction, convection, natural andforced convection, radiation.

**Heattransfer by conduction in Solids:** Fourier's law, thermalconductivity, steady stateconduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres.Unsteadystate heat conduction:Equation for one-dimensionalconduction, Semi-infinite solid.

#### UNIT- II

**Principles of heat flow in fluids:** Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

#### UNIT-III

**Heat Transfer to Fluids without Phase change:** Regimes of heattransfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

# UNIT-IV

**Natural convection:** Natural convection to air from vertical shapes andhorizontal planes, effect of natural convection in laminar-flow heat transfer.

Heat transfer to fluids with phase change: Heat transfer fromcondensing vapors; heat transfer to boiling liquids.

**Radiation:** Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semitransparent materials, combined heat transfer by conduction, convection and radiation.

# UNIT- V

**Heatexchange equipment:** General design of heat exchangeequipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers and heat transfer in packed beds.

**Evaporators:** Evaporators, performance of tubular evaporators, capacityand economy, multiple effect evaporators, methods of feeding, vapor recompression.

#### **Text Books:**

- 1. Unit Operations of Chemical Engineering, 6<sup>th</sup> ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001
- 2. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 1997.

#### **Reference Books:**

- 1. Holman, J.P.S.Bhattacharya, HeatTransfer, 10thEd., TataMcGraw-Hill(2011).
- 2. Chemical Engineering, Volume-I, J. Coulson and R.F. Richardson, Pergamon Press.

#### **CourseOutcomes:**

- 1. Explain the fundamentals of heat transfer and identify principles of different modes of heat transfer
- 2. Illustrate the various heat exchange equipment and calculate various heat transfer coefficients.
- 3. Explain the importance of thermal boundary layer and forced convection.
- 4. Explain in detail about natural convection and radiation.
- 5. Apply the principle of heat transfer in heat exchanger, evaporator design.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year ORGANIC CHEMISTRY

II Year B.Tech. II-Sem

L T PC 3 1 0 4

#### Pre Requisites:NIL

#### **Course Objectives:**

- 1. The fundamental basic mechanisms of various types of Chemical reactions and isomerism are necessary to understand the procedures of synthetic techniques.
- 2. The classification of drugs and mechanism of drug action, and heterocyclics as basic components of various drugs are very important for a chemical engineer.

#### UNIT- I

Bond fission: Homolytic and heterolytic fission of a covalent bond. Types of Reagents: Electrophiles, nucleophiles and free radicals. structure, reactivity, characteristics. Polar effects – Inductive effectelectromeric effect: resonance, hyper conjugation. The influence of these effects on the acidity and basicity of organic compounds. steric inhibition of resonance.

#### UNIT- II

Electrophilic reactions:Introduction – Mechanisms, and synthetic applications - a) Friedel-Crafts reactions b) Riemer- Tiemenn Reaction c) Beckmann rearrangement Nucleophillic reactions:Introduction, mechanisms and applications of a) Aldol condensation b) Suzuki Reaction c) Heck reaction. Free radical reactions: a) Halogenation of Alkane b) Addition of HBr to Alkene in the presence of peroxide. c)Allylic halogenation using NBromo succinimide (NBS)

#### UNIT-III

Classification of drugs: Introduction -Classification by pharmacological effects by chemical structure by target system and by site of action. Pharmacophores - Introduction. Mechanism of drug action: action at enzymes and at receptors. Lipenski rule, Introduction to structure-activity relationships. Classification and examples of antihistamines, antibacterial, anti-inflammatory, antifungal, antibiotics, anti-cancer agents. Chemotherapy.

#### UNIT-IV

Green Chemistry: Introduction, principles of Green Chemistry - Green synthesis, atom economy, solvent free reactions, reactions in solid state, microwave assisted organic synthesis- green catalysts. Introduction to phase-transfer catalysis. Ultra sound assisted reactions. Use of Ionic liquids as green solvents. Advantages and limitations.

#### UNIT- V

Heterocyclic compounds: Nomenclature-preparation, properties and uses of Pyrrole, Furan, Pyridine, Quinoline and Isoquinoline. Dyes: Classification of Dyes with examples. Theories of Colour and Constitution. Witts' Theory and Modern theories.Preparation and uses of Malachite green, Congo red, Bismark brown and Floroscien.

#### **Text Books**

- 1. Text book of Organic Chemistry Morrison and Boyd.
- 2. Medicinal Chemistry by AshutoshKhar, New Age Publications.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **Reference Books**

- 1. Heterocyclic Chemistry by T.Gilchrist
- 2. Heterocyclic Chemistry J.A.Joule, K.Mills and G.F.Smith

#### **Course Outcomes:**

- 1. Describe the various effects on the acidity and basicity of organic compounds.
- 2. Explain the mechanisms involved in various electrophilic reactions.
- 3. Classify the various drugs and explain the pharmacological effects by chemical structure.
- 4. Emphasize on the various principles involved in green chemistry.
- 5. Explain the preparation, properties and uses of various heterocyclic compounds and dyes.

# BASIC ELECTRICAL ENGINEERING LAB

#### II Year B.Tech. II-Sem

# L T P C 0 0 2 1

Pre-Requisites: Basic Electrical Engineering

# **Course Objectives:**

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

# List of Experiments/Demonstrations:

- 1. Verification of Ohms Law.
- 2. Verification of KVL and KCL.
- 3. Transient Response of Series RL and RC circuits for DC excitation.
- 4. Transient Response of RLC Series circuit for DC excitation.
- 5. Resonance in series RLC circuit.
- 6. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits.
- 7. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer.
- 8. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation).
- 9. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star).
- 10. Measurement of Active and Reactive Power in a balanced Three-phase circuit.
- 11. Performance Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
- 12. Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor.
- 13. Performance Characteristics of a Three-phase Induction Motor.
- 14. Torque-Speed Characteristics of a Three-phase Induction Motor.
- 15. No-Load Characteristics of a Three-phase Alternator.
- Any ten experiments will be conducted from the above list

# **Course Outcomes:**

- 1. Get an exposure to basic electrical laws.
- 2. Understand the response of different types of electrical circuits to different excitations.
- 3. Understand the measurement, calculation and relation between the basic electrical parameters
- 4. Understand the basic characteristics of transformers and electrical machines.

#### CHEMICAL TECHNOLOGY AND ORGANIC SYNTHESIS LAB

#### II Year B.Tech. II-Sem

#### L T P C 0 0 2 1

Pre-Requisites: Chemical Technology and Organic Chemistry

# **Course Objectives:**

- 1. To determine the acid, iodine and saponification value of a given sample.
- 2. To estimate the glucose and cellulose content in a given sample.
- 3. To prepare various organic compounds from the given synthesis techniques.

# List of Experiments:

- 1. Determination of Acid value of Coconutoil
- 2. Determination of Iodine value
- 3. Determination of Saponification value
- 4. Estimation of acid insolubles, available lime and calcium carbonate
- 5. Estimation of available chlorine in bleachingpowder
- 6. Estimation of glucose
- 7. Estimation of total cellulose in saw dust
- 8. Preparation of soap
- 9. Preparation of phenol formaldehyde resin.
- 10. Preparation of benzanilide from benzophenone
- 11. Cycloaddition of anthracene with maleic anhyhdride
- 12. Preparation of acetyl salicylic acid (aspirin) from salicylic acid
- 13. Synthesis of styrylbenzimidazole
- 14. Synthesis of N arylphthalimide from phthalic anhydride and p.toluidine
- 15. Synthesis of 2- methyl quinolone from aniline and ethyl acetoacetate

# **Suggested Books:**

- 1. Quantitative and Qualitative analysis in Organic Chemistry- A.I.Vogel.
- 2. Laboratory Manual of Organic Chemistry -R.K. Bansal

# **Course Outcomes:**

- 1. Interpret the acid, iodine and saponification values for any given sample.
- 2. Estimate glucose and cellulose content for a given sample.
- 3. Apply the preparation techniques for soap and resin.
- 4. Prepare aspirin from the given organic compound and reaction involved in it.
- 5. Perform various synthesis reactions.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year PROCESS HEAT TRANSFER LAB

II Year B.Tech. II-Sem

L T P C 0 0 2 1

Pre Requisites: Process Heat Transfer

# CourseObjectives:

- 1. Categorize various heat transfer processes and equipment like heat exchangers and evaporators.
- 2. Impart the knowledge in heat transfer measurements and different heat transfer equipment.
- 3. Demonstrate about natural and forced convection.

#### List of Experiments:

- 1. Determination of total thermal resistance and thermal conductivity of composite wall.
- 2. Determination of thermal conductivity of a metal rod.
- 3. Determination of natural convective heat transfer coefficient for a vertical tube
- 4. Determination of critical heat flux point for pool boiling of water.
- 5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
- 6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
- 7. Determination of heat transfer coefficient for a helical coil in an agitated vessel.
- 8. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
- 9. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
- 10. Determination of Stefan Boltzmann constant.
- 11. Determination of emissivity of a given plate at various temperatures.

# **CourseOutcomes:**

- 1. Explain the basic heat transfer principles.
- 2. Calculate the natural and forced convective heat transfer coefficients.
- 3. Understand the concept of boiling and condensation processes.
- 4. Calculate Stefan-Boltzmann constant.
- 5. Calculate the emissivity for a given plate at various temperatures.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

# CEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year PETROLEUM REFINING AND PETROCHEMICALS (Professional Elective – I)

#### III Year B.Tech. I-Sem

L T P C 3 0 0 3

#### Pre Requisites: NIL

# CourseObjectives:

- 1. To give an outline on the formation, refining of crude oil and products of refinery.
- 2. To identify processing data including thermal properties, important products characteristics of petroleum products.
- 3. Explain about cracking/reforming/alkylation/isomerization/hydrocracking processes.

#### UNIT- I

**Origin, formation and composition of petroleum:** Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry. Petroleum processing data: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

#### UNIT- II

**Fractionation of petroleum:** Dehydration and desalting of crudes, heating of crude pipe still heaters, distillation of petroleum, blending of gasoline. Treatment techniques: fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

#### UNIT- III

**Thermal and catalytic processes:** Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylation processes, Isomerization process.

# UNIT- IV

Petrochemical Industry – Feed stocks Chemicals from methane: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

# UNIT- V

**Chemicals from Ethane-Ethylene-Acetylene:** Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

#### **Text Books:**

Rao, B.K.B. "Modern Petroleum Refining Processes", 4<sup>th</sup>Edition, Oxford and IBH Publishing, 2002.
Nelson. W.L. "Petroleum refining Engineering", 4<sup>th</sup>Edition, Mc Graw Hill, New York, 1969.

#### **Reference Books:**

- 1. Dr.B.K.Bhaskara Rao, "A text on petrochemicals", Khanna Publishers
- 2. Goldstine. R.F. "The Petroleum Chemicals Industry", Taylor and Francis, London, 1967.
- 3. Gruese. W.S.and Stevens, D.R. "Chemical Technology of Petroleum", McGraw Hill, 1980.

4. Chauvel. A. and Lefevrev, "Petro Chemicals", Volume 1 and 2, Gulf Publishing company 1989.

#### CourseOutcomes:

- 1. Describe the formation of crude oil, its refining techniques.
- 2. Explain about the crude oil distillation and its products.
- 3. Acquire knowledge about catalytic cracking / reforming processes.
- 4. Evaluate the petrochemical feedstock for manufacture of various value added chemicals.
- 5. Explain the technologies of low carbon alkane and alkynes based high value chemicals.

# HCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year NUMERICAL METHODS IN CHEMICAL ENGINEERING (Professional Elective – I)

#### III Year B.Tech. I-Sem

L T P C 3 0 0 3

#### Pre Requisite: M-I, M-II

#### **Course Objectives:**

- 1. Introducestudentstonumericalmethodstosolveprocess design problems involved in chemical processes.
- 2. Fundamentals of numerical methods / algorithms to solve systems of different mathematical equations (e.g. linear / non-linear algebraic equations, ordinary / partial differential equations), are introduced.
- 3. To learn regression analysis.

# UNIT- I

**Solution of Linear Algebraic Equations**: Introduction, Gauss- Elimination, LU Decomposition, Gauss-Jordan Elimination, Gauss- Siedel methods. **Solution of Nonlinear Algebraic Equations**: Introduction, Bisection method, Newton-Raphson and Secant method.Chemicalengineeringproblemsinvolvingsolutionoflinear and No-linear algebraicequations.

# UNIT- II

**Regression Analysis**: Introduction, least squares curve-fitting methods, Newton's forward formulae, Newton's backward formulae. Interpolation Polynomial, Lagrangian Interpolation (Unequal Intervals), spline interpolation.

# UNIT-III

NumericalIntegration: Trapezoidalrule, Simpson'srule, integration with unequal segments,Chemicalengineering problems involving numerical differentiation and integration.Chemical

# UNIT-IV

**Solution of ordinary Differential Equations-** Introduction to ordinary Differential Equations, Eulermethod,Runge-Kutta 4<sup>th</sup> order method,AdaptiveRunge-Kuttamethod,Initialandboundaryvalueproblems,Chemicalengineeringproblemsinvolvingsingle, andasystemofODEs.

# UNIT- V

**Solution of PartialDifferentialEquations**:elliptic, parabolic and hyperbolic equations. Finite difference methods, Leibman's method, Crank Nicholson method. Applications to steady state and Unsteady state heat conduction and temperature distribution problems

#### **Text Books:**

1. Numerical Methods for Engineers, S.K. Gupta., New Academic Science., 2012

#### **Reference Books:**

1. S.C. Chapra& R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985.

2. R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.

3. Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.

# **Course Outcomes:**

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

1. Understand the fundamental mathematics and to solve problems of algebraic equations.

2. Solve problems using regression analysis.

3. Solve chemical engineering problems involving numerical differentiation and integration.

4. Solve chemical engineering problems numerically involving ordinary and differential equations.

5. Solve chemical engineering problems numerically involving partial differential equations

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

# INTERFACIAL AND COLLOIDAL SCIENCE

(Professional Elective – I)

#### III Year B.Tech. I-Sem

L T P C 3 0 0 3

#### Pre Requisites: NIL

# **Course Objectives:**

- 1. Understand the basic nomenclature, concepts and tools of colloid and interface science and engineering; multi-phase nano-systems; mechanics and thermodynamics on small scales.
- 2. Explain the difference between the surface and bulk dominated regimes, their behavior and exploitation of nano-systems.
- 3. Importance of various components of interfacial science in different chemical engineering industries viz. food, paint and pharmaceutical industries are emphasized.

#### UNIT I

**Basic concepts of Colloids and Interfaces:** Introduction, Examples of Interfacial Phenomena, Solid-Fluid Interfaces, Colloids. Properties of Colloid Dispersions: Introduction, Sedimentation under Gravity, Sedimentation in a Centrifugal Field, Brownian Motion, Osmotic pressure, Optical properties, Electrical Properties, Rheological Properties of Colloid Dispersions.

#### UNIT II

**Surfactants micelles, films and their properties:**Introduction, Surfactants and their Properties, Emulsions and Microemulsions, foams. Emulsion polymerization, liquid-liquid extraction& membranes.

# UNIT III

**Surface and Interfacial Tension**: Introduction, Surface tension, Interfacial Tension, Contact Angle and Wetting, Shape of the Surfaces and interfaces.Measurement of Surface and Interfacial Tension, Measurement of Contact Angle

# UNIT IV

**Intermolecular and Surface Forces**: Introduction, VanderwallsForces.Intermolecular and Surface Forces: Electrostatic double layer force, The DLVO theory, Non-DLVO forces.

# UNIT V

Adsorption at interfaces: Introduction, The Gibbs Dividing surface, Gibbs Adsorption Equation, Langmuir and Frumkin Adsorption Isotherms, Surface Equation of state(EOS), Effect of Salt on Adsorption of Surfactants. Adsorption Isotherms incorporating the Electrostatic Effects, Calculation of Free energy of Adsorption.

#### **Text Books:**

- 1. Interfacial Science: An Introduction by G.Barnes, I.Gentle, Oxford University Press, USA, 2006.
- 2. Foundations of Colloid Science by R. J. Hunter, 2<sup>nd</sup> edition, Oxford University Press, USA, 2001.

#### **Reference Books:**

- 1. Principles of Colloid and Surface Chemistry, Third edition, Revised and Expanded, Paul C. Hiemenz and Raj Rajagopalan.
- 2. Physical Chemistry of Sciences, 6<sup>th</sup> edition, A. Adamson, 1997.
- 3. Colloid and Interface Science byPallab Ghosh, PHI, New Delhi.

# **Course Outcomes:**

- 1. Distinguish between colloid and interface and explain properties of colloid dispersion
- 2. Explain the differences between surfactants, emulsions
- 3. Apply the methods for measurement of contact angle, surface tension and interfacial tension
- 4. Explain about the various forces acting on colloids
- 5. Explain about the adsorption evaluating techniques.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### MASS TRANSFER OPERATIONS-I

#### III Year B.Tech. I-Sem

# L T PC 3 1 0 4

PreRequisites: Fundamentals of Unit operations

#### **Course Objectives:**

- 1. To discuss the fundamental concepts of mass transfer principles and to apply those concepts to real engineering problems.
- 2. To impart the basic concepts of molecular diffusion, mass transfer coefficients and analysis of different mass transfer processes.
- 3. Applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, interphase mass transfer, equipment for gas-liquid operations.

#### UNIT-I

**Molecular Diffusion in gases and Liquids:**Diffusion and Mass transfer- Mass transfer operations and their applications, Fick's first law – steady state molecular diffusion in binary mixture of gases, liquids.

Molecular diffusion in solids: Diffusion in solids and its application. Types of diffusion in solids, Eddy diffusion.

Diffusivity in gases by Stefan's Method- Estimation of diffusion coefficients in binary mixtures of gases and liquids by correlations.

**Basic concepts of Mass transfer theories:**Film, Penetration, Surface Renewal Theories-Film mass transfer coefficients for the cases of equimolar counter diffusion and diffusion of one component(A) in stagnant component (B), Correlations for Mass transfer coefficients, Reynolds and Colburn analogies.

# UNIT-II

**Inter phase Mass transfer:**Mass transfer coefficients, Relationship between individual and overall mass transfer coefficients, two resistance theory, Gas phase and liquid phase controlled situations.

**Equipment for Gas- liquid operations:**Description of Continuous and stage wise contact equipment – Packing for packed columns-liquid distribution, Mass transfer coefficients in packed columns, Flooding in packed and plate columns,Ideal plate, Murphree, Point, Plate and column efficiency. Comparison of packed and plate columns.

# UNIT-III

Absorption and Stripping: Solubility of gases in liquids, two component system, counter current and co current isothermal absorption and stripping of single component.

Single component absorption material balances –operating lines – Minimum flow rate, Determination of number of transfer units and height of continuous contact absorbers. HETP, NTU,HTU concepts for single component absorption.Counter current multi stage absorption – Determination of number of plates. Absorption factor – Kremser Brown Equation.

# UNIT-IV

**Vapor, Gas Mixtures:**Definition of fundamental terms,Humidity and Relative saturation, Dew point, Theory of Adiabatic saturation and wet bulb temperature, Lewis Relation, Gas liquid contact operations, water cooling with air,Psychometric charts, Enthalpy of gas vapour mixtures.

**Humidification and Dehumidification:** Operating lines and Design of Packed humidifiers, Dehumidifiers and Cooling towers, Spray Chambers, Evaporative cooling.

Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

**Crystallization**: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth,  $\Delta L$  law, crystallization equipment including MSMPR crystallizers.

# **Text Books:**

 R.E.Treybal, MassTransferOperations, 3<sup>rd</sup>Edition, McGrawHill, NewDelhi, 1983.
BinayK.Dutta, Principles of Mass Transfer and Separation Processes, 2nd edition, PrenticeHallofIndia, 2007.

# **Reference Books:**

1. C.J.Geankoplis,TransportProcessesandSeparation Process Principles, 4<sup>th</sup>Edition, Pearson Education2015.

# **Course Outcomes:**

- 1. Recognize the various modes of mass transfer; determine mass transfer rates using Fick's Law.
- 2. Explain about tray column and packed column.
- 3. Design absorption column by various methods.
- 4. Explain the principles of humidification and dehumidification, design the cooling towers.
- 5. Interpret Drying mechanism and principles of crystallization.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **CHEMICAL REACTION ENGINEERING-I**

#### III Year B.Tech. I-Sem

# L T P C 3 1 0 4

# Pre Requisites: NIL

# **Course Objectives:**

- 1. Emphasis on the fundamentals of chemical reaction kinetics and chemical reactor operation.
- 2. Integrate concepts from science & engineering to constitute a basis for the design of chemicalreactor, a key element in the design of chemical process.
- 3. Provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions
- 4. Provide the knowledge about design of reactors.

# UNIT I

Overview of chemical reaction engineering- classification of reactions, variables affecting the rate of reaction definition of reaction rate. Kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

**Interpretation of batch reactor data- constant volume batch reactor**:-Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data– general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions, irreversible reactions in series.

#### UNIT II

**Constant volume batch reactor**–first order reversible reactions, secondorder reversible reactions, reversible reactions in general, reactions of shifting order, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, n<sup>th</sup> order reactions, temperature and reaction rate, the search for a rate equation.

# UNIT III

**Introduction to reactor design-** general discussion, symbols and relationship between  $C_A$  and  $X_A$ . Ideal reactors for a single reaction-Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

**Design for single reactions-** Size comparison of single reactors, Multiple- reactor systems, Recycle reactor, Autocatalytic reactions.

# UNIT IV

**Design for parallel reactions-** introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

**Multiple reactions**-Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment, plug flow or batch reactor, quantitative treatment, mixed flow reactor, first-order followed by zero-order reaction, zero order followed by first order reaction.

#### UNIT V

**Temperature and Pressure effects-** single reactions- heat of reactionfrom thermodynamics, heat of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non-adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

#### **Text Books:**

1. Chemical Reaction Engineering, 3<sup>rd</sup> ed., O. Levenspiel, John Wiely& Sons, 1999.

#### **Reference Books:**

- Elements of Chemical Reaction Engineering, 2<sup>nd</sup> ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.
- 2. Chemical Engineering Kinetics, 3<sup>rd</sup> ed., J.M. Smith, McGraw-Hill, New York, 1981.

#### **Course Outcomes:**

- 1. Fundamentals of rate equation and determination of kinetic order of reaction
- 2. Study the batch reactor kinetics
- 3. Compare ideal reactor types (batch, CSTR and PFR) and apply quantitative methods to design and size reactors for simple chemical reaction schemes.
- 4. Design reactors for single and multiple reactions
- 5. Study the kinetics of the reaction under the effect of pressure and temperature

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### INSTRUMENTATION AND PROCESS CONTROL

#### III Year B.Tech. I-Sem

# L T P C 3 1 0 4

# PreRequisites: Mathematics-II

# **Course Objectives:**

- 1. Describe the various elements of instruments, measurement of temperature, pressure and level in process industries.
- 2. Define the basics of process control and develop transfer function models for dynamic processes.
- 3. Drawthe block diagrams and analyze process stability

# UNIT- I

Elements of instruments, static and dynamic characteristics, basic concepts of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer. Industrial thermocouples, thermocouple wires, thermo couple wells. Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels. Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids.

# UNIT- II

**Introduction to process dynamics and control:** Laplace transforms, Inverse Laplace transform, Response of First Order Systems. Physical examples of first order systems- Liquid level, mixing process, R- C circuit. Linearization.

Response of first order systems in series- interacting and non- interacting systems, second order systems, transportation lag.

# UNIT-III

**Control system:** Components of a control system, Servo Vs regulator problem, development of block diagram.**Controllers and final control elements:** Control valve and its construction, PD, PI, PID controllers.**Stability**: Concept of Stability, Stability criterion, Routh test for stability.

# UNIT-IV

Root locus: concept of root locus, rules for plotting the root locus diagram. Introduction to frequency response: Substitution rule, Bode diagrams Control systems design by frequency response: Bode stability criterion, Gain and Phase margins.

# UNIT- V

**Controller tuning**: Tuning of P, PD, PI, PID controllers, Ziegler- Nichols technique, Cohen and Coon rules. **Advanced control strategies:** Cascade control, feed forward control, ratio control, Smith predictor.

# **Text Books:**

- 1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.
- 2. Process Systems Analysis and Control, 2<sup>nd</sup> ed., D.R. Coughanowr, McGraw-Hill, 1991

# **Reference Books:**

- 1. Chemical Process Control, G. Stephanopoulos, PHI Learning Pvt. Ltd., New Delhi, 2010
- 2. Process Control, B.W. Bequette, PHI Learning Pvt. Ltd., New Delhi, 2010
#### **Course Outcomes:**

- 1. Illustrate thevarious instruments for measuring various process variables such as temperature, pressure, flow.
- 2. Evaluate the transfer functions for various first order and second order examples.
- 3. Explain the various types of controllers using block diagram along with the concept of stability.
- 4. Analyze in more detail the stability criteria using various methods.
- 5. Explain about the various controller tuning techniques.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## CHEMICAL ENGINEERING THERMODYNAMICS-II

### III Year B.Tech. I-Sem

#### L T P C 3 0 0 3

Pre Requisite: Chemical Engineering Thermodynamics-I

## **Course Objectives:**

- 1. To introduce the concepts of fugacity, activity coefficient, chemical potential excess properties.
- 2. To perform the phase equilibrium calculations using simple models for VLE, Gamma/Phi approach and equation of state approach.
- 3. To introduce the concept of chemical reaction equilibria.

## UNIT I

**Solution Thermodynamics:** Theory, Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

## UNIT II

**Solution Thermodynamics:** Applications: The liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing.

VLE at low to moderate pressures: The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations.

## UNIT III

**Thermodynamic Properties and VLE from Equations of State:** properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state.

**Topics in Phase Equilibria:** Equilibrium and stability, Liquid-Liquid Equilibrium (LLE), Vapor- Liquid-Liquid Equilibrium (VLLE), Solid-Liquid Equilibrium (SLE), Solid Vapor Equilibrium (SVE).

## UNIT IV

**Chemical Reaction Equilibria:** The reaction coordinate, application of equilibrium criterion to chemical reactions, The standard Gibb's energy change and the equilibrium constant, effect of temperature on equilibrium constants, relation of equilibrium constants to composition, equilibrium conversion for single reactions, Phase rule and Duhem's theorem for reacting systems.

## UNIT V

**Introduction to Molecular Thermodynamics:**Molecular Theory of Fluids,Second Virial Coefficients from Potential Functions,Internal Energy of Ideal Gases: Microscopic view, thermodynamic properties and statistical mechanics, hydrogen transfer and charge transfer complexing, behaviour of excess properties.

#### **Text Books:**

1. Introduction to Chemical Engineering Thermodynamics, 7<sup>th</sup> ed., J.M. Smith, H.C. Van Ness and M.M. Abbott, Tata McGraw-Hill, New Delhi, 2015.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Reference Books:**

- 1. Y.V.C.Rao, Chemical Engineering Thermodynamics, University publications
- 2. K.V. Narayanan, Chemical Engineering Thermodynamics, PHI, 2001

## **Course Outcomes:**

- 1. Explain in detailaboutsolution thermodynamics and phase equilibrium
- 2. Generate VLE data; to check the consistency of experimental VLE data; to calculate bubble and dew points
- 3. Calculate differences in thermodynamic properties using equations of state.
- 4. Learn chemical reaction equilibrium; to calculate equilibrium conversion for homogeneous and heterogeneous reactions
- 5. Explain the importance of molecular thermodynamics

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## ADVANCED ENGLISH COMMUNICATION SKILLS LAB

## III Year B.Tech. I-Sem

L T P C 0 0 2 1

## 1. Introduction

The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> 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.
- Activities on Presentation Skills Oral presentations (individual and group) through JAM sessions/seminars/<u>PPTs</u> and written presentations through posters/projects/reports/ e-mails/assignments etc.

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

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**, 7<sup>th</sup> Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dreamtech
- TOEFL &GRE(KAPLAN, AARCO&BARRONS, USA, Cracking GRE by CLIFFS)

## 6. Books Recommended:

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

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## MASS TRANSFER OPERATIONS LAB-I

### III Year B.Tech. I-Sem

L T P C 0 0 3 1.5

Pre Requisites: Mass Transfer Operations-I

### **Course Objectives:**

- 1. Study about diffusion and diffusivity coefficient for various systems such as, Liquid-liquid and Vapor-gas system.
- 2. Explain the hydrodynamics of single drop extraction, perforated plate tower.
- 3. Estimate the mass transfer coefficients for given system such as packed bed absorption, wetted wall tower, humidification and de-humidification.

## List of Experiments

- 1. Determination of diffusivity coefficient for a given Liquid- Liquid system.
- 2. Determination of diffusivity coefficient for a given Vapor-Gas system.
- 3. Determination of mass transfer coefficient for Surface Evaporation of a liquid.
- 4. Study of hydrodynamics of single drop extraction.
- 5. Study of Hydrodynamics of perforated plate tower.
- 6. Determination of mass transfer coefficient in a wetted wall tower.
- 7. Determination of mass transfer coefficient in packed bed absorption.
- 8. Determination of characteristic curves in a batch drying.
- 9. Mass transfer coefficient in Humidification and De-Humidification

## **Course Outcomes:**

- 1. Explain the VLE, LLE systems
- 2. Explain about diffusion and diffusivity coefficient for any given system.
- 3. Explain the hydrodynamics of given system.
- 4. Estimate the mass transfer coefficient for any given system.
- 5. Evaluate the characteristic curves in a batch drying.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

## INSTRUMENTATION AND PROCESS CONTROL LAB

### III Year B.Tech. I-Sem

## L T P C 0 0 3 1.5

Pre Requisites: Instrumentation and Process Control

## **Course Objectives:**

- 1. Study about process dynamics and various forms of mathematical models to express them
- 2. Determine the time lag for first and second order systems.
- 3. Emphasize theoretical concepts of open and close loop runs on liquid level and liquid temperature.

## List of Experiments:

- Calibration and determination of time lag of various first and second order instruments Major equipment - First order instrument like Mercury-in-Glass thermometer and Overall second order instrument like Mercury-in-Glass thermometer in a thermal well
- Experiments with single tank system.
  Single tank Step Response
  Single tank Impulse Response
- 3. Experiments with two tank system with interaction. Interacting Tanks – Step Response Interacting Tanks – Impulse Response
- 4.Experiments with two tank system without interaction. Non Interacting Tanks – Step Response Non Interacting Tanks – Impulse Response
- Level control trainer
  Major equipment Level control trainer set up with computer

6. Temperature control trainer Major equipment - Temperature control trainer with computer

- 7. Experiments on proportional, reset, rate mode of control etc. Major equipment – PID control apparatus
- 8. Control valve characteristics Major equipment – Control valve set up
- 9. Estimation of damping coefficient for U-tube manometer Major equipment - U-tube manometer.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Course Outcomes:**

- 1. Calculate the time lag for first and second order systems.
- 2. Compare and contrast the response for interacting and non-interacting systems.
- 3.Compare the open and closed loop systems.
- 4. Evaluate the controller actions for level and temperature control for a given process.
- 5. Compare the different types of controllers.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year SOLID WASTE MANAGEMENT (Open Elective – I)

#### III Year B.Tech. II-Sem

L T P C 3 0 0 3

## Pre Requisites: NIL

## **Course Objectives:**

- 1. To understand the sense of onsite handling storage and collection systems including transportation
- 2. To understand the various processing technologies with mechanical volume reduction and thermal volume reduction corporate land filling, deep well injections.
- 3. Learn to estimate material recovery a energy recovery from a given waste data using case standing

## UNIT- I

**Introduction:** Definition, characteristics and perspectives of solid waste. Types of solid waste. Physical and chemical characteristics. Variation of composition and characteristics. Municipal, industrial, special and hazardous wastes.

**General aspects:** Overview of material flow in society. Reduction in raw material usage. Reduction in solid waste generation. Reuse and material recovery. General effects on health and environment. Legislations.

#### UNIT- II

**Engineered systems:** Typical generation rates. Estimation and factors effecting generation rates. On site handling. Storage and processing. Collection systems and devices. Transfer and transport.

#### UNIT-III

**Processing Techniques:** Mechanical volume reduction. Thermal volume reduction. Component separation. Land filling and land forming. Deep well injection.

#### UNIT-IV

**Material recovery:** Mechanical size alteration. Electromagnetic separation. Drying and dewatering. Other material recovery systems. Recovery of biological conversion products. Recovery of thermal conversion products.

**Energy recovery:** Energy recovery systems and efficiency factors. Determination of output and efficiency. Details of energy recovery systems. Combustion incineration and heat recovery. Gasification and pyrolysis. Refuse derived fuels (RDF).

### UNIT- V

**Case studies:** Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

### **Text Books:**

- 1. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
- 2. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

## **Reference Books:**

- 1. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
- 2. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

## **Course Outcomes:**

- 1. Apply the knowledge of characterization of waste and develop a suitable management plan
- 2. Describe various transfer and transportation techniques.
- 3. Describe various processing techniques.
- 4. Suggest processing waste for material for energy recovery.
- 5. Application of solid waste management techniques in various industries.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **BASICS OF NANOTECHNOLOGY**

(Open Elective – I)

III B.Tech. Chem. Engg. II-Semester	L	Т	Р	С
	3	0	0	3

## Pre Requisites: NIL

**Course Objectives:** 

1. Discuss about the basics of nanotechnology

- 2. Classify and explain the various properties of nano materials
- 3. Describe the various methods for synthesis of nano materials and their applications

## UNIT- I

**Introduction:** History and Scope, Can Small Things Make a Big Difference? Classification of Nano structured Materials, Fascinating Nanostructures, Applications of Nano materials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

## UNIT- II

Unique Properties of Nano materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations.

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

## UNIT-III

**Magnetic Properties**: Soft magnetic nano-crystalline alloy, Permanent magnetic nano-crystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

## UNIT- IV

**Synthesis Routes: Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly

#### UNIT- V

Top down approaches: Mechanical alloying, Nano-lithography.

**Consolidation of Nano powders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Applications of Nano materials: Nano-electronics, Nanosensors, Nanocatalysts, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications

## **Text Books:**

- 1. Text Book of Nano Science and Nano Technology B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
- 2. Introduction to Nanotechnology Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

## **Reference Books:**

- 1. Nano: The Essentials by T.Pradeep, Mc Graw-Hill Education.
- 2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
- 3. Transport in Nano structures- David Ferry, Cambridge University press 2000.

## **Course Outcomes:**

- 1. Describe the importance of nano structured materials.
- 2. Explain the effect of nano dimensions on material behavior properties.
- 3. Explain the various magnetic properties of nano materials.
- 4. Describe the various routes for nano material preparation.
- 5. Describe about the nano powders and application of nano materials in various fields.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year MATERIALS SCIENCE (Professional Elective – II)

### III Year B.Tech. II-Sem

L T P C 3 0 0 3

**Pre Requisites**: Structure of Materials, Crystallography, phase diagram **Course Objectives**:

- 1. To describe materials behaviour to different conditions in different phase.
- 2. To select materials for suitable design to manufacture machine.
- 3. To estimate the properties for alternate materials such as alloys, composites.

## UNIT-I

Introduction:Engineering Materials– Classification– levels of structure.Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non-crystalline solids; ionic, covalent and metallic solids; packing efficiency, ligancy and coordination number; structure determination by Bragg's X-ray diffraction and powder method.

#### UNIT-II

Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation, role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations.

## UNIT-III

Basic thermodynamic functions; phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rules, non-equilibrium cooling: phase diagrams of Fe-Fe<sub>3</sub>C, Pb-Sn, Cu-Ni systems.

Phase transformations in Fe-Fe<sub>3</sub>C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

#### UNIT-IV

Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, viscoelastic behavior (models); shear strength of real and perfect crystals work hardening mechanisms cold working, hot working; dynamic recovery, recrystallization, grain growth, grain size and yield stress Brief description of heat treatment in steels.

Magnetic materials: Terminology and classification, magnetic moments due to electron spin, ferro-magnetism and related phenomena, domain structure, hysteresis loop, soft and hard magnetic materials.

## UNIT-V

Fracture in ductile and brittle materials creep: mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials.

Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

#### **Text Books:**

1. Materials Science and Engineering, 5<sup>th</sup> ed. V. Raghavan, PHI Learning Pvt. Ltd., New Delhi, 2009. **Reference Books:** 

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 1. Elements of Materials Science, L.R. Van Vlack,
- 2. Science of Engineering Materials, vols. 1&2, ManasChanda, McMillan Company of India Ltd.

## **Course Outcomes:**

- 1. Identify crystal structure of various materials and techniques used for structure determination.
- 2. Analyze the influence of defects on the properties of materials ·
- 3. Illustrate the fundamentals of equilibrium phase diagrams.
- 4. Devise various fabrication techniques used for manufacturing common engineering materials.
- 5. Explain fatigue and fracture mechanism and estimate suitable corrosion resistant material and design corrosion protection equipment.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year RENEWABLE ENERGY (Professional Elective – II)

III Year B.Tech. II-Sem

L T P C 3 0 0 3

Pre Requisites: Knowledge of various Energy Sources

### **Course Objectives:**

- 1. Understand the various forms of conventional energy resources.
- 2. Summarize the present energy scenario and the need for energy conservation
- 3. Explain the concept of various forms of renewable energy

## UNIT I

## INTRODUCTION

World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable Development, Energy planning. Classification of Energy resources, Advantages and Disadvantages of Non-Conventional source of energy, Renewable energy resources - potentials -achievements – applications.

## UNIT II

## SOLAR ENERGY

Basic concepts, Solar thermal systems – Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques – Solar desalination – Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar greenhouse- Solar thermal power plant –Solar photo voltaic conversion – Solar cells – types of PV technologies, PV applications.

## UNIT III

#### WINDENERGY

Introduction-Background-Availability- wind power plants, Power from the wind, Wind energy conversion systems, site characteristics, Wind turbines types – Horizontal and vertical axis-design principles of wind turbine, Magnus effect- Performance. Wind energy Applications – New developments - Safety and environmental aspects

#### UNIT IV

## **BIOMASS ENERGY**

Biomass – usable forms- composition- fuel properties – applications, Biomass resources, Biomass conversion technologies - direction combustion - pyrolysis – gasification -anaerobic digestion, Bioethanol and Biodiesel Production – Recent developments. Energy farming, Biogas technology - Family biogas plants, Community and institutional biogas plants – design consideration – applications.

## UNIT V

#### **OTHER RENEWABLE ENERGY SOURCES**

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy Fuel cell technology - types, principle of operation – applications. Hydrogen energy production - Storage system.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Text Books:**

- 1. Rai. G.D. "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
- 2. Sukhatme. S.P. "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

### **Reference Books:**

- 1. Kothari. P, K C, Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Pvt. Ltd.,New Delhi, 2008
- 2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
- 3. Twidell. J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
- 4. Tiwari. G.N. Solar Energy Fundamentals Design, Modelling and applications, Narosa Publishing House, NewDelhi, 2002.

## **Course Outcomes:**

- 1. Describe the needof renewable energy resources, historical and latest developments.
- 2. Describe the use of solar energy in different applications like heating, cooling, desalination, power generation, drying, cooking etc.
- 3. Describe the need of Wind Energy and Biomass energy resources
- 4. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
- 5. Evaluate the potential of fuel cells, wave power, tidal power and geothermal principles and their applications.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year FLUIDIZATION ENGINEERING (Professional Elective – II)

IIIYear B.Tech. II-Sem

L T P C 3 0 0 3

## Pre Requisites: Fluid Mechanics, MTO-I

### **Course Objectives:**

- 1. Explain the basic principles of fluidization phenomena
- 2. Describe the fundamental and practical aspects of basic fluidization operations for industrial application.
- 3. Explain in detail about the fluidized bed regimes and models.

## UNIT- I

**Introduction:** The phenomenon of fluidization; liquid like behavior of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

**Industrial applications of fluidized beds:** Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; FCCU; Fluidized combustion of coal; gasification of waste.

## UNIT- II

**Fluidization and mapping of regimes:** Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles, Transport disengaging height; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

#### UNIT-III

**Bubbles in dense bed:** Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles.

**Bubbling Fluidized beds:** Experimental findings; Estimation of bed Voidages; Physical models: simple two phase model; K-L model.

## UNIT-IV

High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.

Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds.

#### UNIT- V

**Gas Dispersion and Gas interchange in Bubbling Beds:** Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients.

**Particle to Gas Mass Transfer:** Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

#### **Text Books:**

1. Fluidization Engineering by Kunil, Diazo and Octave Levenspiel, John Weiley& Sons Inc, Newyork, 1969.

2. Fluidization Engineering by J.R. Howard, Adam Heilgar.

### Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e

#### **Reference Books:**

- 1. Yates, J.G., Fundamentals of Fluidized Bed Chemical Processes, Butterworth-Heinemann (Butterworth's Monographs in Chemical Engineering) (1983).
- 2. Yang, W. and Amin, N.D., Fluidization engineering: fundamentals and applications, American Institute of Chemical Engineers (1988)

#### **Course Outcomes:**

- 1. Illustrate the fluidization phenomena and operational regimes.
- 2. Explain theminimum fluidization velocity along with effects of temperature and pressure on fluidization.
- 3. Explain about the bubbles and evaluate the gas flow at the bubbles.
- 4. Explain about high velocity fluidization.
- 5. Explain about experimental interpolation of mass transfer coefficients.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## PROCESS MODELING AND SIMULATION

### III Year B.Tech. II-Sem

## L T P C 3 1 0 4

**Pre Requisites**: Chemical Reaction Engineering-I, Process heat transfer, Mass transfer operations-I **Course Objectives**:

- 1. To impart knowledge on modeling of various equipment and their simulation using different numerical techniques.
- 2. Formulate a chemical engineering problem as a mathematical model, and select an appropriate solution method.
- 3. Formulate and solve process design problems, based on fundamental analysis and using mathematical models of chemical processes

## UNIT- I

**Introduction:** Uses of mathematical models, Principles of formulation, fundamental laws: Continuity equation, component Continuity equation, energy equation, Equation of motion.Classification of mathematical models-steady state Vs dynamic models, lumped Vs distributed parameter models, deterministic Vs stochastic models.

#### UNIT- II

**Examplesof mathematical models of chemical engineering systems:** Series of isothermal constant hold-up CSTRs, CSTRs withvariable hold-ups, two heated tanks, gas phase pressurized CSTR, Non-isothermal CSTR.

#### UNIT-III

**Examplesof mathematical models of chemical engineering systems:** Single component vaporizer, batch reactor, reactor withmass transfer, ideal binary distillation column, batch distillation with hold-up.

#### UNIT-IV

Empirical model building- method of least squares, linear, polynomialand multiple regression, non-Linear regression.

**Process Simulation examples**: VLE dew point and bubble pointcalculations, binary distillation column, gravity flow tank, batch reactor, Non- isothermal CSTR, counter current heat exchanger.

#### UNIT- V

**Process simulation using modular and equation based solving approaches**: Modular approaches to process simulation: Analysis VsDesign mode, sequential modular approach, Simultaneous modular approach, Equation solving approach, Introduction to various simulation software packages in chemical engineering.

#### **Text Books:**

1. Process Modeling, Simulation and Control for Chemical Engineers, 2<sup>nd</sup> ed., W. L.

Luyben, McGraw-Hill, New York, 1990.

2. Process Plant Simulation, B.V.Babu, Oxford University Press, 2004

#### **Reference Books:**

1. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995.

2. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Course Outcomes:**

- 1. Understand the stages involved in the development of a process model.
- 2. Formulate a chemical engineering problem as a mathematical model from basic engineering principles.
- 3. Identify the appropriate numerical solutions used in solving the models.
- 4. Solve problems using least square analysis.
- 5. Apply various simulation tools for solving the chemical engineering models developed.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### MASS TRANSFER OPERATIONS-II

#### III Year B.Tech. II-Semester

## L T P C 3 1 0 4

Pre Requisites: Mass Transfer Operations-I

## **Course Objectives:**

- 1. To describe stage wise mass transfer operations, principles of various stage wise contact processes like distillation, extraction, leaching, adsorption and drying
- 2. To design a distillation column, as well as design of a adsorber and calculations involved in liquid-liquid extraction and drying
- 3. To justify the selection of solvents for leaching and extraction.

## UNIT -I

**Distillation:**Principles of VLE for binary systems, VLE phase diagrams, Tie line and mixture rule, Relative volatility, Ideal solutions, azeotropes. Methods of Batch Distillation: Flash, Differential and steam Distillation, Batch Distillation with reflux for binary mixture, continuous fractionation of binary mixtures.

## UNIT -II

**Multistage tray towers-** PonchonSavaritMethod,Mc-Cabe& Thiele method of determination of ideal plates for binary mixtures- Enriching section, exhausting section, feed location, total reflux, minimum and optimum reflux ratios, use of total and partial condensers, use of open steam system, types of condensers and reboilers. Packed bed distillation, Principles of azeotropic and extractive distillation.

## UNIT-III

**Liquid- Liquid Extraction:** Solubility of ternary liquid systems, Triangular and solvent free coordinate (rectangular coordinate) systems, choice of solvent, Extraction with insoluble and partially soluble systems. Single stage and multistage cross current and multistage counter current extraction without reflux and with reflux, fractional extraction, Continuous contact extraction (Packed beds), Equipment for liquid- liquid extraction operation, use of super critical fluid in extraction.

## UNIT-IV

**Leaching:** Introduction, leaching process, preparation of solid for leaching, Rates of leaching, Steady-stae and unsteady state operation, in situ leaching. Heap leaching, percolation leaching, Shanks systems, Agitated vessels, Percolation Vs Agitation. Steady state continuous operation- equipment for leaching–methods of calculation. Stage efficiency and particle equilibrium, Single stage leaching, multistage cross current leaching, multistage counter current leaching (under variable underflow and constant underflow conditions)

## UNIT-V

Adsorption:Principles of adsorption and their applications, types of adsorption, Industrial adsorbents, adsorption equilibrium, adsorption isotherms for vapour and dilute solutions, Freundlich equation, Langmuir and BET isotherms. Single stage and multistage adsorptions, unsteady state adsorption, adsorption wave and breakthrough curveand fixed bed adsorption. Equipment for adsorption (single stage and continuous contact), Ion exchange. Crystallization.

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

**Drying:**Theory and mechanism of drying, Moisture content of solids, Equilibrium, bound, unbound free and critical moisture contents. Drying conditions, Rate of Batch drying, drying time of Batch drying, through circulation drying, Design of Batch and continuous dryers.

## **Text Books:**

1.R.E.Treybal, MassTransferOperations, 3<sup>rd</sup>Edition, McGrawHill, NewDelhi, 1983.

2. BinayK.Dutta, Principles of Mass Transfer and Separation Processes,2nd edition, Prentice HallofIndia,2007

3. W.L.McCabe, J.Smithand P.Harriot, UnitOperations of Chemical Engineering,

7<sup>th</sup>Edition,TataMcGrawHill,India,2014.

## **Reference Books:**

1. C.J.Geankoplis, Transport ProcessesandSeparation Process Principles, 4th Edition, Pearson Education2015.

## **Course Outcomes:**

- 1. Describe how batch distillation is conducted in several ways
- 2. Design distillation equipments with simple and rigorous methods
- 3. Examine liquid-liquid extraction
- 4. Separate the components by leaching
- 5. Interpret the principles of fixed bed adsorption

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year CHEMICAL REACTION ENGINEERING-II

#### III Year B.Tech. II-Sem

L	Т	Р	С
3	1	0	4

## Pre Requisites: Chemical Reaction Engineering-I

## **Course Objectives:**

- 1. Learn the importance of RTD and the various models such as compartmental models, dispersion model, tanks in series model for modeling of Non-ideal flow reacting vessels.
- 2. Knowledge of rate law given the rate controlling step in catalytic reactions, internal and external diffusion effects.
- 3. Shrinking core model for spherical particles of unchanging size and design the fluid-solid reactors.

## UNIT- I

**Basics of non-ideal flow**: E, the exit age distribution function of fluid, theRTD, conversion in non-ideal flow reactors, diagnosing reactors (qualitative discussion only). The dispersion model: axial dispersion, correlations for axial dispersion, chemical reaction and dispersion.

## UNIT- II

**The tanks in series model**: pulse response experiments and the RTD, chemical conversion. The convection model for laminar flow- the convective model and its RTD, chemical conversion in laminar flow reactors. Earliness of mixing, segregation and RTD: self-mixing of a single fluid, mixing of two miscible fluids.

#### UNIT-III

**Catalysis and Catalytic reactors**: catalysts, steps in catalytic reactions, synthesizing a rate law, mechanism and rate limiting step. (From chapter 10, Fogler)

**Heterogeneous reactions**: Introduction to Solid catalyzed reactions: Therate equation for Surface Kinetics-Pore diffusion resistance combined with surface kinetics, Porous catalyst particles, heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

## UNIT- IV

**Solid catalyzed reactions:** Experimental methods for finding rates. Deactivating catalysts- mechanisms of catalyst deactivation, the rate and performance equations.

#### UNIT-V

**Fluid-fluid reactions**: kinetics- the rate equation. **Fluid-particle reactions**: kinetics- selection of a model, shrinking coremodel for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

#### **Text Books:**

Chemical Reaction Engineering, 3<sup>rd</sup> ed., O. Levenspiel, John Wiley & Sons, 1999.
 Elements of Chemical Reaction Engineering, 4<sup>th</sup> ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.

## **Reference Books:**

- 1. Chemical Engineering Kinetics, 3<sup>rd</sup> ed., J.M. Smith, McGraw-Hill, New York, 1981.
- The Engineering of Chemical Reactions, 2<sup>nd</sup> ed., L.D. Schmidt, Oxford University Press, New Delhi, 2010

### **Course Outcomes:**

- 1. Distinguish between various RTD curves and predict the conversion from a non-ideal reactor using tracer information.
- 2. Develop rate laws for heterogeneous reactions.
- 3. Design of reactors for non-catalytic and catalytic reactions.
- 4. Evaluate the rate and performance equations for deactivating catalysts.
- 5. Design fluid-solid reactors.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## PROCESS SIMULATION LAB

III Year B.Tech. II-Sem

L T P C 0 0 2 1

Pre Requisites: Process Modeling and Simulation, Process Dynamics and Control

### **Course Objectives:**

- 1. Solve the various process simulation problems using MATLAB or C.
- 2. Illustrate the open loop and closed loop systems.
- 3. Illustrate the bubble point and dew point calculations in VLE systems.

The following experiments have to be conducted using C or MATLAB

- 1. General introduction to MATLAB
- 2. Functions (log, exp, conv, roots).
- 3. Matlab Scripts and function files
- 4. Gravity Flow tank.
- 5. Three CSTRs in series open loop
- 6. Three CSTRs in series Closed loop
- 7. Non isothermal CSTR
- 8. Binary Distillation column
- 9. Batch Reactor isothermal; Batch reactor non isothermal closed loop
- 10. Isothermal batch reactor open loop
- 11. Heat Exchanger
- 12. Interacting System- two tank liquid level
- 13. Non interacting system-two tank liquid level
- 14. Plug flow reactor
- 15. Bubble point calculations
- 16. Dew point calculations

#### **Course Outcomes:**

- 1. Formulate the process simulation problems using MATLAB or C.
- 2. Compare the open loop and closed loop systems.
- 3. Explain the isothermal and non-isothermal systems.
- 4. Explain the difference between interacting and non-interacting systems.
- 5. Describe the bubble point and dew point calculations in a given VLE systems.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

## MASS TRANSFER OPERATIONS LAB-II

## III Year B.Tech. II-Sem

L T P C 0 0 3 1.5

Pre Requisites: Mass Transfer Operations-II

## **Course Objectives:**

- 1. Illustrate the types of distillation.
- 2. Compute the H.E.T.P of a packed bed distillation column.
- 3. Generate the equilibria data for a given system

## List of Experiments

- 1. Steam distillation.
- 2. Differential distillation.
- 3. Determination of H.E.T.P of a packed bed distillation column.
- 4. Determination of Vapor-Liquid equilibria for a given system.
- 5. Determination of Ternary Liquid equilibria for a given system.
- 6. Determination of Liquid-Liquid equilibria for a given system.
- 7. Determination of oil content in the given sample of oil bearing material.
- 8. Determination of stage efficiency in single and multi-stage liquid liquid extraction
- 9. Ion Exchange

## **Course Outcomes:**

- 1. Explain the different types of distillation
- 2. Evaluate the H.E.T.P of a packed bed distillation column.
- 3. Evaluate the equilibria data for any given system
- 4. Estimate the oil content in a given oil bearing sample.
- 5. Explain the stage efficiencies for a single and multi-stage extraction.
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## CHEMICAL REACTION ENGINEERING LAB

## III Year B.Tech. II-Sem

## L T P C 0 0 3 1.5

Pre Requisites: Chemical Reaction Engineering-I, Chemical Reaction Engineering-II

## **Course Objectives:**

- 1. To impart knowledge on the determination of the kinetics of a chemical reaction.
- 2. Analyze the concentration versus time data and determine the specific rate constant and the order of the reaction.
- 3. Explain about the various parameters of non-ideal flow models, RTD in CSTR, PFR, packed bed

## List of Experiments

- 1. Determination of the order of a reaction using a batch reactor and analyzing the data by
- (a) differential method (b) integral method.
- 2. Determination of the activation energy of a reaction using a batch reactor
- 3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
- 4. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
- 5. To determine the order of the reaction and the rate constant using a tubular reactor.
- 6. CSTRs in series- comparison of experimental and theoretical values for space times and volumes of reactors.
- 7. Mass transfer with chemical reaction (solid-liquid system) determination of mass transfer coefficient.
- 8. Axial mixing in a packed bed. Determination of RTD and dispersion number for a packed-bed using a tracer
- 9. Determination of RTD and dispersion number in a tubular reactor

## **Course Outcomes:**

- 1. Calculate the order and kinetics of simple reactions
- 2. Evaluate the reaction rate constant of a reaction of a known order using batch reactor.
- 3. Compare the various types of reactors and their mode of operation
- 4. Calculate the residence time distribution (RTD) characteristics of all basic reactors including packed column reactor
- 5. Explain the concepts of dispersion number
- 6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year INDIAN CONSTITUTION

III Year B.Tech. II-Sem

L T P C 2 0 0 0

## Pre-Requisites: Nil

Course Objectives: Students will be able to:

- 1. Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective.
- 2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indiannationalism.
- 3. To address the role of socialism in India after the commencement of theBolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

## UNIT – I:

## History of Making of the IndianConstitution:

- History
- Drafting Committee, (Composition& Working)

## Philosophy of the IndianConstitution:

- Preamble
- Salient Features

## UNIT – II:

## Contours of Constitutional Rights & Duties:

- Fundamental Rights
- Right toEquality
- Right toFreedom
- Right againstExploitation
- Right to Freedom of Religion
- Cultural and EducationalRights
- Right to ConstitutionalRemedies
- Directive Principles of StatePolicy
- Fundamental Duties.

## UNIT – III:

## **Organs of Governance:**

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions

## **Executive:**

- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

#### UNIT – IV:

#### LocalAdministration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative CEO of MunicipalCorporation.
- Pachayati raj: Introduction, PRI:ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position androle.
- Block level: Organizational Hierarchy (Differentdepartments),
- Village level: Role of Elected and Appointedofficials,
- Importance of grass rootdemocracy

#### UNIT – V:

#### **ElectionCommission:**

- Election Commission: Role and Functioning.
- Chief Election Commissioner and ElectionCommissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC andwomen.

#### **Text Books:**

- 1. The Constitution of India, 1950 (Bare Act), GovernmentPublication.
- 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

#### **Course Outcomes:**

Students will be able to:

- 1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indianpolitics.
- 2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution inIndia.
- 3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the IndianConstitution.
- 4. Discuss the passage of the Hindu Code Bill of1956

### INDUSTRIAL POLLUTION CONTROL ENGINEERING (Open Elective – II)

IV B.Tech. I-Semester

#### LTPC

3 0 0 3

#### Pre Requisites: NIL

### **Course Objectives:**

- 1. To understand various air pollution control techniques.
- 2. To understand various biological treatment methods of waste water.
- 3. To understand various physical treatment methods of waste water.

#### UNIT-I

Introduction to industrial pollution and types of pollution from chemical industries, Effects of pollution as environment and ecosystems-global warming-greenhouse effect; Environmental legislation-standards and guidelines, water act 1974, air act 1981.

#### UNIT –II

Air pollution-Meteorological aspects of pollution dispersion-adiabatic lapse rate-Environmental lapse rate-Turbulence and stability of atmosphere, Richardson number-Plume raise-plume behavior and characteristics, effective stack height. Major air pollutants and their sources, measurement of air pollutants

#### UNIT -III

General methods of control air pollutants removal of sulphur dioxide, oxides of nitrogen and organic vapors from gaseous effluents; Removal of particulate matter – principle and working of setting chambers, cyclone separators, fabric and fibre filters – electro static precipitators, Treatment of gaseous effluents.

#### UNIT -IV

**Introduction to water pollution** – water pollutants classification –characteristics of liquid effluents from fertilizer, pulp & paper and petroleum industries, estimation of oxygen demands – DO, BOD, COD, TOC – BOD curves, oxygen sag curve – modeling of BOD curves

**Biological treatment of waste waters** – aerobic and anaerobic methods– suspended and attached growth processes – bacteria – Reproduction in bacterial – Bacterial growth crushes, conventional activated sludge process – Trickling filters, Aerated lagoons – stabilization ponds – fluidized bed contractors.

#### UNIT -V

**Physical Treatment methods** : Principle and working of screening –sedimentation – flotation – filtration – flocculation, Tertiary Treatment methods – carbon adsorption – lon exchange – Reverse Osmosis, Boralin Chlorinating – Ultra filtration, Sludge treatment and disposal , removal of chromium and phenol from liquid effluents.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Text Books:**

1.Pollution control in process industries by S.P. Mahajan TMH.,1985

2. Waste water treatment by M.Narayana Rao and A.K.Datta, Oxford and IHB publisher, New Delhi.

## **Reference Books:**

- 1. Environmental pollution and control engineering by Rao C. S. –Wiley EasternLimited, India, 1993.
- 2. Air pollution control by P. Prathapmouli and N. Venkatasubbayya. Divya Jyothi Prakashan, Jodhpur.

## **Course Outcomes:**

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

- 1. Understand the different types of wastes generated in an industry, their effects on living and non-living things.
- 2. Understand environmental regulatory legislations and standards and climate changes.
- 3. Understand the atmospheric dispersion of air pollutants, and operating principles, design calculations of particulate control devices.
- 4. Understand about the quantification and analysis of wastewater and treatment.
- 5. Understand the different unit operations and unit processes involved in conversion of highly polluted water to potable standards.

## DESIGN AND ANALYSIS OF EXPERIMENTS

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## (Open Elective – II)

IV Year B.Tech. I-Semester

LTPC

3 0 0 3

## Pre Requisites: Mathematics-III

## **Course Objectives:**

- 1. Review on how the design of experiments is useful during research and finds the most significant factor for an experiment.
- 2. Calculate the factor levels that optimize the outcome of an experiment.
- 3. Explain about the Factorial Design of experiments.

## UNIT- I

Introduction to the role of experimental design; basic statistical concepts; sampling and sampling distribution; Testing of hypotheses about differences in means- randomized designs and paired comparison designs; testing of hypotheses about variances.

## UNIT- II

Analysis of variance (ANOVA) –one-way classification ANOVA; analysis of fixed effects model; comparison of individual treatment means; the random effects model; the randomized complete block design

## UNIT-III

Factorial design of experiments; two-factor factorial design-fixed effects and random effects model; General factorial design; analysis of  $2^k$  and  $3^k$  factorial designs.

## UNIT-IV

Conforming in the  $2^k$  factorial design in 2p block; confounding in the  $3^k$  factorial design in 3p block; Fractional replication of the  $2^k$  factorial design and the  $3^k$  factorial design.

## UNIT- V

Regression analysis- Simple and multiple linear regression and hypothesis testing; response surface methodology-the method of steepness ascent: response surface designs for first-order and second-order models. Evolutionary operation (EVOP).

#### **Text Books:**

1.Design and analysis of experiments, 2<sup>nd</sup>edn.,D.C.Montgomery, John Wileyand Sons, New York, 2003.

#### **Reference Books:**

1. Design and Analysis of Experiments, Narayan C Giri, New Age International, 1988.

**Course Outcomes:** 

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

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

- 1. Explain the basic concepts and models of experimental design.
- 2. Analyze the results of a designed experiment in order to conduct appropriate statistical analysis of data.
- 3. Perform factorial design of experiments
- 4. Illustrate the strategy in planning and conducting experiments.
- 5. Apply response surface methodology to optimize the process by considering the curvature.

BIOCHEMICAL ENGINEERING (Professional Elective – III)

IV Year B.Tech. I-Sem

L T P C 3 0 0 3

## Pre Requisites: NIL

## **Course Objectives:**

- 1. Relate the chemical engineering principles to biochemical systems.
- 2. Be able to explain the biological systems and kinetics of enzymatic reactions.
- 3. Learn the kinetics of growth of microorganisms; hence be able to control the process.

## UNIT- I

**Introduction to microbiology:** Biophysics and the cell doctrine, the structure of cells, important cell types, from nucleotides to RNA and DNA, amino acids into proteins.

**Enzyme Kinetics:** Kinetics of single-substrate enzyme catalyzed reactions, Michaelis - Menten equations, Brigg's Haldane equation & estimation of constants using graphical techniques, Turnover number ( $k_{cat}$ ). Kinetics for reversible reactions, Enzyme inhibition kinetics: reversible and irreversible inhibition, substrate, product and toxic substances inhibition.

#### UNIT- II

**Pre-steady-state and multi-substrate enzyme kinetics:**pre-steady-state kinetics: Rapid mixing, Stopped flow and Relaxation techniques, Determination of the number of active sites of enzyme and determination of rate constants. Enzyme kinetics at limiting conditions: Dilute substrates, solid substrates and enzyme activity at interfaces.

**Kinetics of multi-substrate reactions:** Mechanism for two substrates reactions, compulsory order, random order reactions and Ping-Pong mechanism.

#### UNIT- III

**Enzyme immobilization & kinetics of immobilization:** Immobilization of Biocatalysts an Introduction, Electrostatic effect, Effect of charged and uncharged support, Effect of external and internal mass transfer, Effect of Intra-particle diffusion with uncharged supports, Simultaneous external and internal mass transfer resistances and partitioning effects. Dam Kohler number and effectiveness factor.

#### UNIT-IV

**Unstructured model for microbial growth:** The development of different microbial growth kinetics like Malthus, Pearl and reed, Monod Model, Konark Model. The limitation of Monod model and development of other constitutive models of growth.

**Sterilization:** Media sterilization, Kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilization, coupling of Arrhenius equation and cell death kinetics, sterilization of air and filter design, Radiation and Chemical sterilization.

UNIT- V

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

**Bioreactors:** Different types of Bioreactor, Different modes of operation, Main components of the bioreactor and their functions. Bioreactor design: Batch reactor, cell death in batch reactor, chemostat, endogenous metabolism, maintenance, product & substrate inhibition on chemostat, multiple steady state analysis, enzyme catalysis in CSTR, cascade reactor, plug flow reactor, fed batch reactor, Chemostat with cell recycle and feed forward control.

## **Text Books:**

- 1. Biochemical Engineering Fundamentals, 2nd ed., J.E. Bailey and D.F. Ollis, McGraw-Hill, New York, 1987.
- 2. Blanch HW and Clark DS: Biochemical Engineering Marcel Decker (1987).

## **Reference Books:**

- 1. Biochemical Engineering, J. M. Lee, Prentice-Hall, New Jersey 1992.
- 2. Bioprocess Engineering Principles, P. M. Doran, Elsevier, Gurgaon.
- 3. Bioprocess Engineering, 2nd ed., M. L. Shuler and F. Kargi, PHI Learning Pvt. Ltd, New Delhi, 2009.

## **Course Outcomes:**

- 1. Evaluate the kinetics of enzyme action in substrate and inhibitor.
- 2. Determine the rate constants and understand the kinetics involved in enzyme activity.
- 3. Describe the biocatalysts involved in enzyme immobilization and evaluate the kinetics of the reaction.
- 4. Evaluate the kinetics and mechanism of microbial growth.
- 5. Design the various bioreactors and explain their mode of operation.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year CORROSION ENGINEERING (Professional Elective – III)

IV Year B.Tech. I-Sem

L T P C 3 0 0 3

### Pre Requisites: NIL

## **Course Objectives:**

- 1. Introduce the principles of electrochemistry as well as the essential elements of electrochemical corrosion.
- 2. Define and describe the forms of corrosion, the mechanisms of corrosion, electrochemical methods.
- 3. Develop the thermodynamic and kinetic aspects of electrochemistry, including potential-pH

#### UNIT- I

**Introduction:** Definitions of Corrosion - Overall classification of types of Corrosion-Basic electrochemistry – Galvanic and electrolytic cells – Potential measurements - EMF and Galvanic series – Galvanic corrosion and bimetallic contacts – Eh – pH diagrams, Cost of Corrosion, Metallurgical properties influencing corrosion.

#### UNIT- II

**Forms of Corrosion:**Uniform attack, galvanic, crevice, pitting, inter granular, selective leaching, erosion and stress corrosion – Mechanisms, testing procedures and their protection.

#### UNIT-III

**Electrode kinetics and polarization phenomena:** Electrode – solution interface – Electrode kinetics and polarization phenomena – Exchange current density – Polarization techniques to measure corrosion rates – Mixed potential theory – Activation and diffusion controlled mixed electrodes.

#### UNIT-IV

**Methods of corrosion prevention and control:**Design, coatings and inhibition – Cathodic protection – Stray current corrosion – Passivity phenomena and development of corrosion resistant alloys – Anodic control.

#### UNIT- V

**Industry Approach:** Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given ChemicalEnvironment. -Ferritic, Austenitic steels and stainless steels- Copper and its Alloys-Brasses, bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

#### **Text Books:**

M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company.
 Denny A Jones, Principles and Prevention of Corrosion (second edition), Prentice-Hall, N. J. (1996).

#### **Reference Books:**

1. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY) (1985).
#### **Course Outcomes:**

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

1. Define corrosion and explain the various types of corrosion along with their metallurgical properties.

2. Describe the various mechanisms for testing corrosion.

3. Apply the electrode kinetics and evaluate the corrosion rate using polarization techniques.

4. Describe the various prevention and control methods for corrosion.

5. Apply the corrosion testing methods in Chemical Engineering Industry.

## H B.Tech.(Reg), w.e.f. 2019-20 Academic Year WATER CONSERVATION AND MANAGEMENT

(Professional Elective – III)

#### IV Year B.Tech. I-Sem

L T P C 3 0 0 3

#### Pre Requisites: Water resources and Preservation methods

#### **Course Objectives:**

- 1. To apply concepts of water resources management and design techniques.
- 2. To plan and design water harvesting and groundwater recharge structures.
- 3. To design water supply and sanitation system.

## UNIT- I

**Introduction:**water cycle, waterstorage, water quality; water conservation in homes; water conservation in the work place, water resources planning. Water resources systems – irrigation management, water quality management, groundwater management, water conveyance and distribution systems.

## UNIT- II

**Design Techniques:** Environmental Restoration. Evaluate results of participatory mapping of water resources and challenges, soil and water conservation, conservation through reforestation. Check dams for controlling runoff and plugging gullies.

## UNIT- III

**Introduction:** concept of watershed, need for watershed management, concept of sustainable development and Hydrology of small watersheds. Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures. Artificial recharge of groundwater in small watersheds, methods of artificial recharge.

## UNIT- IV

**Introduction:** Epidemiological aspects of water quality- methods for low cost water treatment - Specific contaminant removal systems. Water quality monitoring

## UNIT- V

**Water Conservation in Industries:** Conservation of Water for Cooling, Water Conservation in Pre-treatment Plant, Water Conservation in Softening Plants, Water Conservation in Demineralization Plant, Treatment of Condensate, Treatment and Disposal of wastewater in process industry. Water Recycling and Water Audit.

#### **Text Books:**

- 1. Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008
- 2. Loucks, D.P. and Eelco van Beek (2005), "Water Resources Systems Planning and Management An introduction to methods, models and applications", Studies and Reports in Hydrology, UNESCO Publishing.

#### **Reference Books:**

- 1. Mohan Seneviratne., A Practical Approach to Water Conservation for Commercial and Industrial Facilities, 1st Edition, Elsevier Science, 2007.
- 2. Jeff Sturman, GoenHo, Kuruvilla Mathew., Water Auditing and Water Conservation, IWA Publishing, 2004.
- 3. Claude E. Boyd., Water Quality: An Introduction, springer Science & Business Media, 2000.
- 4. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) "Water Resources Systems Planning and Analysis", Prentice Hall Inc. N York
- 5. Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998

#### **Course Outcomes:**

- 1. Explain water resource planning.
- 2. Prepare water auditing to be able to apply the principles to many situations and make recommendations for water conservation measures.
- 3.Design low cost water management system.
- 4. Predict water quality and conservation.
- 5. Practice industrial water conservation techniques.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## POLYMER SCIENCE AND ENGINEERING

(Professional Elective – IV)

#### IV Year B.Tech. I-Sem

LTPC

3 0 0 3

## Pre Requisites: NIL

## **Course Objectives:**

- 1. To provide a broad and fundamental knowledge of the polymers and their chemical, physical and mechanical behaviour.
- 2. Emphasize on the processing techniques, along with the production of polymers.
- 3. The student should be able to correlate structure-processing-properties relationships for polymers, blends and composites.

## UNIT- I

**Basic Concepts:** Concepts and classification of polymers, Functionality, Glass transition temperature, Addition, condensation, step-growth and chain-growth polymerization, Molecular weight estimation: Number and weight average, Sedimentation and viscosity average molecular weights, Molecular weight and degree of polymerization, Polydispersity, Significance of molecular weight.

## UNIT- II

**Polymerization Processes:** Bulk, solution, emulsion and suspension polymerization, Comparison of polymerization processes.

## UNIT-III

**Polymerization Kinetics:** Chemistry of step reaction polymerization, Mechanism and kinetics of poly condensation reactions, Relationship between average functionality, extent of reaction and degree of polymerisation. Mechanism and kinetics of free- radical chain polymerization, kinetic chain length, chain transfer reactions, Inhibition and retardation

## UNIT-IV

**Synthetic Fibres:** Types of Fibres, Spinning Techniques, Manufacturing Technology and Applications of different types of fibres: cellulosic fibres, polyamides, acrylics, vinyls and vinylidines, fluorocarbons.

**Plastics:** Manufacturing Technology and applications of different types of plastics: Polyester, polyethylene, Phenolics.

## UNIT- V

**Plastics:** Rubbers, structure, properties and preparation natural rubber synthetic rubbers: SBR, rubber compounding and reclaiming.

#### Testing and Evaluation of plastics and rubbers:

Physical testing, Electrical Properties, Softening Temperature tests, Melt flow Index.

## **Text Books:**

- 1. Gowariker V. R., Viswanathan N. V., Sreedhar J., "Polymer Science", New Age International Publishers, (1996).
- 2. Billmeyer F. W., "Text Book of Polymer Science", Wiley Tappers, (1994).

## **Reference Books:**

- 1. Ghosh P., "Polymer Science and Technology of Plastics and Rubber", Tata McGraw Hill, (2001).
- 2. Gupta R. K., Kumar A., "Fundamentals of Polymer Engineering", 2nd Edition, Marcel Dekkar, (2003).
- 3. Fried J. R. "Polymer Science and Technology", PHI Learning, (2008).

## **Course Outcomes:**

- 1. Understand the structure-processing-property relationship of polymers.
- 2. Illustrate different polymerization processes.
- 3. Understand the kinetics of various polymerization techniques.
- 4. Describe the manufacturing techniques of different synthetic fibers and plastics.
- 5. Describe testing and evaluation of plastics and rubbers.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year COMPUTATIONAL FLUID DYNAMICS (Professional Elective – IV)

IV Year B.Tech. I-Sem

LTPC

3 0 0 3

Pre Requisites: NIL

## **Course Objectives:**

- 1. Apply finite difference, finite volume and finite element methods to fluid flow problems.
- 2. To relate brief introduction of Computational Fluid Dynamics along with chemical engineering application specifically, analysis of fluid mechanics and heat transfer related problems.
- 3. Analyze issues surrounding two-phase flow modeling and grid generation.

## UNIT I

Introduction - Finite difference methods- finite element method - finite volume method- Treatment of boundary conditions- Governing differential equations. Finite difference methods - Taylor's series - Errors associated with FDE- FDE formulation for steady state heat transfer problems.

## UNIT II

Cartesian, cylindrical and spherical coordinate systems- boundary conditions- Un steady state heat conduction Explicit Method - Stability criteria - Implicit Method - Crank Nickolson method - 2-D FDE formulation ADI-ADE. Finite volume method - Generalized differential equation, Basic rules for control volume approach, Source term linearization, boundary conditions. Un-steady state one, two, three dimensional heat conduction.

#### UNIT III

Convection and diffusion, different methods i.e., upwind scheme, Exponential scheme, Hybrid scheme, power law scheme, calculation of flow field, staggered grid method, pressure and velocity corrections, SIMPLE Algorithms & SIMPLER (revised algorithm). Solution methods of elliptical, parabolic and hyperbolic partial differential equations in fluid mechanics - Burgers equation.

#### UNIT IV

Formulations for incompressible viscous flows - vortex methods pressure correction methods.

#### UNIT V

Treatment of compressible flows- potential equation, Navier - Stokes equation - flow field dependent variation methods, boundary conditions. Linear fluid flow problems, 2-I) and 3-1) fluid flow problems.

#### **Text Books:**

1. Numerical heat transfer and fluid flow - S.V. Patankar

2. Computational Fluid Dynamics, T.J. Chung, Cambridge University.

#### **Reference Books:**

1. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

#### **Course Outcomes**:

- 1. Solve PDEs.
- 2. Use finite difference and finite volume methods in CFD modeling.
- 3. Generate and optimize the numerical mesh.
- 4. Simulate simple CFD models and analyze is results.
- 5. Analyze issues of two-phase flow modeling.
- 6. Apply equations of fluid flow and heat transfer for turbulence models.
- 7. Apply finite volume to solve fluid flow problems

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year NUCLEAR ENGINEERING (Professional Elective – IV)

IV Year B.Tech. I-Sem

L T P C 3 0 0 3

# Pre Requisites: Process Heat Transfer

## **Course Objectives:**

- 1. To learn the basics of Nuclear physics
- 2. Understand the principles of Nuclear reactions and reactors
- 3. Know the safety aspects of Nuclear installations

## UNIT- I

Introduction: Motivation for Nuclear Energy, India's Nuclear Power Program

**Nuclear Physics:** Nuclear model of the atom - Equivalence of mass and energy - Binding - Radio activity - Half life - Neutron interactions - Cross sections.

## UNIT-II

## **Nuclear Reactions and Reactor Materials**

Mechanism of nuclear fission and fusion - Radio activity - Chain reactions - Critical mass and composition - Nuclear fuel cycles and its characteristics - Uranium production and purification - Zirconium, thorium, beryllium.

## UNIT-III

**Reprocessing:**Nuclear fuel cycles - spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment.

## UNIT-IV

**Nuclear Reactors:** Reactors - Types of fast breeding reactors - Design and construction of fast breeding reactors - heat transfer techniques in nuclear reactors - reactor shielding.

## UNIT-V

**Safety, Disposal and Proliferation:** Nuclear plant safety- Safety systems - Changes and consequences of an accident - Criteria for safety - Nuclear waste - Type of waste and its disposal - Radiation hazards and their prevention - Weapons proliferation.

#### Text Books:

1. Thomas J.Cannoly, "Fundamentals of Nuclear Engineering ", John Wiley (1978).

2. G, Vaidyanathan," Nuclear Reactor Engineering", Chand Publishers, 2013

#### **Reference Books:**

1. Collier J.G., and G.F.Hewitt, " Introduction to Nuclear Power ", (1987), Hemisphere Publishing, New York.

2. Lamarsh U.R. " Introduction to Nuclear Engineering Second Edition ", (1983), Addison Wesley M.A.

3. Lipschutz R.D. " Radioactive Waste - Politics, Technology and Risk ", (1980), Ballingor, Cambridge. M.A.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Course Outcomes:**

- 1. Summarize about the concepts of nuclear physics
- 2. Design the reactor components and explain about the nuclear reactions.
- 3. Explain about the nuclear cycles.
- 4. Explain about the various nuclear reactors and the heat transfer techniques involved.
- 5. Evaluate the various hazards and safety measures involved while handling the reactors.

# JHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year CHEMICAL PROCESS TECHNOLOGY AND ECONOMICS

#### IV Year B.Tech. I-Sem

L	Т	Р	С
3	0	0	3

## Pre Requisites: NIL

## **Course Objectives**:

- 1. Describe the various organic and inorganic chemicals along with their manufacturing processes.
- 2. Explore the various operating variables, engineering problems encountered within the manufacturing processes.
- 3. Identify the economic aspects involved within the manufacturing processes.

## UNIT- I

Chlor-Alkali Industry: Manufacture of Soda ash, caustic soda, and chlorine.

Nitrogen Industries: Manufacture of synthetic ammonia, urea, nitric acid,(ammonium nitrate), ammonium chloride, ammonium phosphate, and complex fertilizers.

## UNIT- II

**Sulphur and sulphuric acid:** manufacture of sulphuric acid, hydrochloric acid and some other chemicals aluminiumsulphate and alum. Cement Manufacture, Special cements. Manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol-formaldehyde resin and polyvinyl chloride polymer, SBR.

#### UNIT-III

**Soaps and Detergents:** Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

**Pulp and Paper Industry**: methods of pulping, production of sulphate and sulphite pulp, production of paper -- wet process.

## UNIT- IV

Introduction, Cost and asset accounting, cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment.

**Interest and investment costs**: types of interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due interest on investment, source of capital.

#### UNIT- V

**Depreciation**: types of depreciation, service life, salvage value, present value, methods for determining depreciation, single and unit depreciation.

**Profitability**: alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, pay out period, alternative investments, analysis with small investments, increments and replacements.

## **Text Books:**

- 1. Shreve's Chemical Process Industries by Austin, Mc-Graw Hill, 5<sup>th</sup> edition 1985.
- 2. Dryden's outlines of Chemical Technology by M.Gopal Rao and M.Sittig, 2<sup>nd</sup> ed. 1973.
- 3. Plant Design and Economics for Chemical Engineering, 4<sup>th</sup> ed., M.S.Peters and K.D.Timmerhaus, Mc-Graw Hill, 1991.

## **Reference Books:**

- 1. Process Engineering Economics, Schewyer.
- 2. Handbook of industrial chemistry Vol I and II K.H.Davis and F.S.Berner edited by S.C.Bhatia, CBS publishers.

## **Course Outcomes:**

- 1. Draw block diagrams / process flow diagrams of the processes used for manufacture of industrially important chemicals.
- 2. Explain the processes involved in manufacturing of sulphur and nitrogen industries.
- 3. Explain about soaps and detergents and illustrate the manufacturing process of pulp and paper.
- 4. Explain about the cash flow involved in general for any manufacturing process plant.
- 5. Estimate the profitability for a particular project.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year TRANSPORT PHENOMENA

#### IV Year B.Tech. I-Sem

L T P C 3 0 0 3

**Pre Requisites**: Fluid mechanics, Process Heat Transfer, CRE-I, CRE-II **Course Objectives**:

- 1. Practice the concepts of Momentum, heat and mass transport
- 2. Solve the problems on Momentum, Energy and Mass transfer
- 3. To develop Model Equation for prototype system to scale up

#### UNIT-I

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids. Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density. Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

#### UNIT- II

Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

#### UNIT-III

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

#### UNIT-IV

Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

#### UNIT- V

The equations of change: Derivation of the equation of continuity in Rectangular and Polar coordinates, the equation of motion, the equation of energy, the equation of continuity of a component in multi component mixture (in rectangular coordinates only) the equations of change in terms of the substantial derivative. Use of equations of change to solve one dimensional steady state problems of momentum, heat and component transfer, Introduction to Turbulent flow and Time smoothing.

#### **Text Books:**

1. Transport phenomena by Bird R.B., Stewart W.C., Lightfoot F.N., 2<sup>nd</sup> ed. John Wiley & Sons Inc, U.S.A, 1960.

#### **Reference Books:**

- 1. Transport phenomena for engineers by L. Theodore, International text book company, U.S.A.1971.
- 2. Transport processes and unit operations by C.J. Geankoplis, PHI, 3<sup>rd</sup> ed. 1997.
- 3. Fundamental of heat, momentum and mass transfer, Welty, Wickson, Wilson, John Wiley.

#### **Course Outcomes:**

.

- 1. Identify the chemical and physical transport processes and their mechanism.
- 2. Analyze momentum transfer problems with shell balance.
- 3. Analyze shell energy balance problems along with appropriate approximations and boundary conditions.
- 4. Develop shell mass balance and analyze problems related to mass transfer.
- 5. Solve transport problems with turbulent flow and derive the equations of change.

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year INDUSTRY ORIENTED MINI PROJECT / INDUSTRIAL TRAINING

IV Year B.Tech. I-Sem	$\mathbf{L}$	Т	Р	С
	0	0	4	2

Pre Requisites: All the subjects till the current semester

## **Course Objectives:**

- 1. To offer students a glimpse into real world problems and challenges that need Chemical Engineering based solutions.
- 2. To enable students to create very precise specifications of the Chemical Engineering problems to be solved.
- 3. To introduce students to the vast array of literature available of the various research challenges in the present scenario of different industries.

## **Course Outcomes:**

- 1. Discover the potential research areas in Chemical Engineering involving various applications.
- 2. Conduct a survey of several available literatures in the preferred field of study.
- 3. Compare and contrast the several existing solutions for research challenge.
- 4. Demonstrate an ability to work in teams and manage the conduct of the research study.
- 5. Formulate and propose a plan for creating a solution for the research plan identified.
- 6. Report and present the findings of the study conducted in the preferred domain.

## B.Tech.(Reg), w.e.f. 2019-20 Academic Year SEMINAR

## IV Year B.Tech. I-Sem

L	Т	Р	С
0	0	2	1

# Pre- Requisites: Nil

# **Course Objectives:**

- 1. The prime objective of this course is to make students become effective communicators and enhance their presentational and creative abilities.
- 2. Enhance the technical knowledge of the selected topics.

#### **Course Outcomes:**

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

## **MAJOR PROJECT (PHASE-I)**

LTPC

0 00 3

# IV Year B.Tech. I-Sem

## Pre Requisites: NIL

#### **Course Objectives:**

- 1. To create awareness among the students about the characteristics of several domain areas where Chemical Engineering applications can be effectively used.
- 2. To enable students to use all the concepts of Chemical Engineering in selecting a problem.
- 3. To improve the team building, communication and management skills of the students.

#### **Course Outcomes:**

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

- 1. Explain the importance of the proposed problem and the challenges faced due to that in the current scenario in industries.
- 2. Propose research question and present them in a clear and distinct manner through different sources using oral, written and design techniques.
- 3. Propose the various problem solving methodologies and discuss the time-plans and strategies in using those methods.
- 4. Compare and contrast the several existing solutions and explain in detail about the proposed solving technique.
- 5. Evaluate and comment on other student's research questions and their project proposals.

## INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

B.Tech.(Reg), w.e.f. 2019-20 Academic Year (Open Elective – III)

IV Year B.Tech. II-Sem

LTPC

3 0 0 3

Pre Requisites: NIL

#### **Course Objectives:**

- 1. To describe awareness of different hazards in process industries
- 2. To show classification of hazards and their identifications
- 3. To demonstrate precautions in chemical storage and handling

## UNIT- I

Introduction, Factors Contributing to the Costs of Accidents, List of some Notable accidents in the process industry/selected case histories, some common features of high cost accidents, reasons for high priority towards safety.

## UNIT- II

Material hazards1: Introduction Hazardous substances-categories, Toxicity, Radiation, Flammability, Ignition, Fires and explosions.

## UNIT-III

Material hazards 2: Fire balls, Fire damage, run away chemical reaction, incompatible materials, material safety and data sheets

Process and plant Hazards: Hazards of pressure, causes of over pressures, flow deviations, effects of leakages/releases, hazards of temperatures.

## UNIT-IV

Hazard analysis: process safety management, process hazards analysis, hazards analysis methods, check list, preliminary hazard analysis, what-if / check list, hazard and operability analysis, FMEA, Fault tree analysis, cause and consequence analysis.

#### UNIT- V

Preventive and protective measures: Safety options, process safety approaches, inherent safety and design, plant layout, inherent security, explosion prevention and protection, personal protective systems, plant modifications and management change, relief valves and rupture discs, breather vents for storage tanks, explosions vents, flame arresters, flare systems

#### **Text Books:**

- 1. Chemical process industry safety by K S N Raju, Mc-Graw Hill education (India) Pvt.Ltd,2014
- 2. Chemical process Safety by Crowl

#### **Reference Books:**

1. Chemical process safety by Sanders

#### **Course Outcomes:**

# Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 1. Illustrate the history accidents and priority towards safety.
- 2. Categorize hazards in industries
- 3. Prepare material safety and data sheet
- 4. Practice HAZOP, Fault tree analysis and other loss prevention techniques.
- 5. Devise and design safety equipments in a planned manner

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## ENERGY ENGINEERING (Open Elective – III)

IV year B.Tech. II-Sem

LTPC

3 0 0 3

Pre Requisites: NIL

#### **Course Objectives:**

- 1. Explain about the conventional energy sources and their utilization.
- 2. Describe the importance of heat recovery and energy conservation methods and energy audit
- 3. Identify different types of fuel sources for energy production.

#### UNIT- I

**Sources of energy, types of fuels**- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.

**Coal:** origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

#### UNIT- II

Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels. Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus.

#### UNIT- III

**Steam Plant:** Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage.

#### UNIT-IV

Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers

Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

#### UNIT- V

**Energy auditing:** short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

#### **Text Books:**

1. Fuels, Furnaces and Refractories, O.P.Gupta

2. Fuels and Combustion, 3<sup>rd</sup> ed., Samir Sarkar, Universities Press, 2009.

#### **Reference Books:**

- 1. Non-conventional Energy Resources, G.D.Rai, Khanna Publishers.
- 2. Fuel and Energy, Harker and Backhurst, Academic press London 1981.
- 3. Fuel Science- Harker and Allen, Oliver and Boyd, 1972.

## **Course Outcomes:**

- 1. Describe about conventional energy sources and discuss about various types of fuels.
- 2. Explain the importance and applications of liquid fuels.
- 3. Illustrate about the importance of steam along with various energy sources.
- 4. Explain the various waste heat recovery techniques.
- 5. Analyze energy audits applying various schemes.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year OPTIMIZATION METHODS (Professional Elective – V)

IV Year B.Tech. II-Sem

Pre Requisites: NIL

# **Course Objectives:**

- 1. To learn problem formulation of optimization.
- 2. To realize the numerical methods of un-constrained optimization.

3. To learn linear programming and its applications

## UNIT- I

**Nature and organization of optimization problems**: introduction to optimization scope and hierarchy of optimization, examples of applications of optimization, essential features of optimization problems, general procedure for solving optimization problems, Optimization of a manufacturing problem with a stepwise procedure, obstacles of optimization, constraints in optimization, examples and formulation of constrained optimization problems.

**Basic concepts of optimization**: Continuity of functions, unimodal versus Multi model functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function.

#### UNIT- II

**Optimization of unconstrained single variable functions:** Region elimination methods: Fibonacci search, Golden section search. Polynomial approximation methods- Sequential search. Methods specifying optimum by a point: Newton's method, Secant method, Quadratic interpolation, Cubic interpolation. Applications of one dimensional search methods to chemical engineering problems.

#### UNIT- III

Unconstrained multivariable optimization: Random search methods, grid search, uni-variate search, multivariable Newton's method, steepest descent method, Conjugate search directions, Conjugate gradient method, Powell's method.

#### UNIT-IV

**Optimization of Unit operations:** Optimal pipe diameter, minimum work of compression, optimizing recovery of waste heat, optimization of multiple effect evaporator, shell and tube heat exchanger.

#### UNIT- V

**Linear programming and applications:** Basic concepts in linear programming, graphical solution, artificial variable technique, exceptional cases in LPP, non-existing feasible solution, degeneracy, duality in linear programming, dual simplex method, revised simplex method.

## **Text Books:**

1. Optimization of Chemical Processes, T.F. Edgar and D.M. Himmelblau, McGraw-Hill, New York, 2001.

2. Optimization for Engineering Design, Kalyan Moy Deb, PHI Pvt. Ltd., New Delhi, 2000.

L T P C 3 0 0 3

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **Reference Books:**

- 1. S.S.Rao, Engineering Optimization Theory and Practice, 3<sup>rd</sup> edition, New Age International Publishers, India.
- 2. K.Deo, Optimization techniques, Wiley Eastern, 1995.

## **Course Outcomes:**

- 1. Knowledge of optimization to formulate the problems and analyze the optimization criterion for solving problems.
- 2. Apply different methods of single variable optimization and to suggest a technique for specific problem.
- 3. Apply various methods of multivariable optimization techniques or specific problem.
- 4. Understand the optimization of various unit operations.
- 5. Describe linear programming with its applications.

## JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS (Professional Elective – V)

#### IV Year B.Tech. II-Sem

L T P C 3 0 0 3

## Pre Requisites: NIL

## **Course Objectives:**

- 1. To provide knowledge on various grades of chemicals and sources of impurities.
- 2. To provide the basic knowledge of principles involved in the identification and estimation of pharmaceutical substances.
- 3. To provide the basic knowledge on pharmaceutical unit operations and manufacturing processes.

## UNIT- I

A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

## UNIT- II

Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, riboflavin, nicotinamide,

Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

## UNIT-III

Manufacture with flowsheets, properties, uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate.

## UNIT- IV

Manufacture with flowsheets, properties, uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

#### UNIT- V

Tablet making and coating, granulation equipments, Preparation of capsules, extraction of crude drugs.Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

#### **Text Books:**

1. Remington's Pharmaceutical Science, 16<sup>th</sup>ed, Mac publishing company, 1980.

2. Industrial Chemicals, 3rd ed., Faith, Kayes and Clark, John Wiley & Sons, 1965.

#### **Reference Books:**

1. Blently's Text Book of Pharmaceutical Chemistry, 8th ed, H A Rawlins,

2. B Tindell and Box, Oxford University Press, London, 1977.

#### **Course Outcomes:**

- 1. Understand the knowledge of base chemicals and drug intermediates.
- 2. Describe the preparation and their properties of various pharmaceuticals and fine chemicals.
- 3. Describe the properties and uses of some pharmaceuticals with flow sheets.
- 4. Draw flow sheets for manufacture of fine chemicals with their properties and uses.
- 5. Understand tablet making and coating, preparation of capsules and extraction of crude drugs.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year FUEL CELL TECHNOLOGY (Professional Elective – V)

IV Year B.Tech. II-Sem

L T P C 3 0 0 3

Pre Requisites: Hydrogen energy and fuel cells

## **Course Objectives:**

- 1. To describe how to produce, store, use hydrogen and show the difficulties.
- 2. To present hydrogen applications especially fuel cells.
- 3. To describe working principle of fuel cell.
- 4. To describe manufacture and workingprinciple of SOFC

## UNIT- I

**Overview of Fuel Cells:** What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

## UNIT- II

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others, liquid hydrogen and compressed hydrogen-metal hydrides, alkaline fuel cell.

## UNIT-III

**Fuel cell electrochemistry:** electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents, current density, power density, potential and thermodynamics of fuel cell, Introduction to direct methanol fuel cell.

**Fuel cell process design:** Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

## UNIT- IV

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling.

#### UNIT- V

**Fuel processing:** Direct and in-direct internal reforming, Reformation of hydrocarbons by steam,  $CO_2$  and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal, Using renewable fuels for SOFCs.

#### **Text Books:**

- 1. Hoogers G., Fuel Cell Technology Hand Book, CRC Press, 2003.
- 2. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

## **Reference Books:**

- 1. F. Barbir, PEM Fuel Cells: Theory and Practice, 2nd Ed., Elsevier/Academic Press, 2013.
- 2. Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications, 2003.
- 3. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, Fuel Cell Fundamentals, Wiley, NY 2006.
- 4. Fuel cells for automotive applications -professional engineering publishing UK.

#### **Course Outcomes:**

- 1. Learn working principle of fuel cells.
- 2. Understand the hydrogen production and storage methods.
- 3. Select the suitable materials for electrode, membrane for fuel cells.
- 4. Be familiar with fuel cell types and their applications.
- 5. Design and stack making process.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year FOOD PROCESSING TECHNOLOGY (Professional Elective – VI)

IV Year B.Tech. II-Sem

L T PC 3 0 0 3

**Pre Requisites**: Mechanical Operations, Fluid Mechanics, Process Heat Transfer, Material and Energy Balance Computations.

#### **Course Objectives:**

- 1. To impart knowledge to the students about food processing and various unit operations involved in it.
- 2. To learn about the principles, equipment of food processing and methods that affect the quality of food products.
- 3. Aim to learn the difference between microwave and conventional heating.

## UNIT- I

**Food process engineering - Fundamentals**: Fundamentals of foodprocess engineering, application of quantitative methods of material and energy balances in food engineering practices.

## UNIT- II

Unit Operations in food industries: Fluid flow, thermal processcalculations, refrigeration, evaporation and dehydration operations in food processing.

## UNIT- III

**Microwave heating:** Theory of microwave heating, microwave properties of foods, comparison of microwave and conventional heating, benefits of microwave heating, applications in food processing, microwave heating equipment, hazards of microwave heating.

## UNIT- IV

**Mechanical Operations in food processing**: Conversion operations, Size reduction and screening of solids, mixing and emulsification, filtration and membrane separation, centrifugation, crystallization, extraction.

## UNIT- V

**Preservation operations:** Preservation methods & Strategies, ThermalMethods, Nabla Factor Sterilization Types Pasteurization Dehydro freezing Irradiation Dosimetry Transport of food & Preservation strategies Cheap and applicable everywhere.

#### **Text Books:**

1. R. T. Toledo, "Fundamentals of Food Process Engineering", AVI Publishing Co., 1980.

- 2. P.G.Smith, "Introduction to Food Process Engineering", Springer 2003.
- 3. R. Angold, G. Beech and J. Taggart, "Food Biotechnology", Cambridge University Press, 1989.

#### **Reference Books:**

- 1. J. M. Jackson and B. M. Shinn, "Fundamentals of Food Canning Technology", AVI Publishing Co., 1978.
- J. G. Bernnan, J. R. Butters, N. D. Cowell and A.E.V.Lilley, "Food Engineering Operations", 2<sup>nd</sup>Edn., Applied Science, 1976.
- 3. Fundamentals of Food Engineering, D G Rao, PHI, New Delhi, 2012.

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **Course Outcomes:**

- 1. Interpret the material and energy balances in food engineering processes.
- 2. Understanding the various causes of food deterioration and food poisoning.
- 3. Compare microwave versus conventional heating.
- 4. Learn chemical unit operations involved in food processing.
- 5. Analyze product quality and effect of processing technique on it and identify appropriate processing, preservation, and packaging methods.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year MEMBRANE TECHNOLOGY (Professional Elective – VI)

#### IV Year B.Tech. II-Sem

Pre Requisites: NIL

#### **Course Objectives:**

- 1. Explain the basic principles of membraneseparation processes.
- 2. Describe about the characterization of membrane.
- 3. Introduce the concepts of polarization, fouling, module and process design
- 4. Review the membrane modules used for the industrial applications
- 5. Discuss the preparation of synthetic membranes

## UNIT- I

**Introduction:** Separation processes, Introduction to membrane processes, definition of a membrane, classification of membranes. Preparation of Synthetic membranes: Types of Membrane materials, preparation of Synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, and preparation technique for composite membranes.

## UNIT- II

Characterization of membranes; Introduction, membrane characterization, characterization of porous membranes, characterization of non-porous membranes.

Transport in membranes: introduction, driving forces, non-equilibrium thermodynamics, transport through porous, non-porous, and ion exchange membranes.

#### UNIT-III

**MembraneProcesses:**Introduction,Osmosis,pressuredrivenmembrane processes: Introduction, microfiltration, membranes for microfiltration, industrial applications, ultrafiltration: membranes for ultrafiltration, industrial applications, reverse Osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications, Electrically Driven processes: Introduction, electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Bipolar membranes, Fuel Cells.

#### UNIT-IV

Concentration driven membrane processes: gas separation: gas separation in porous and non-porous membranes, membranes for gas separation, applications, pervaporation, membranes for pervaporation, applications, dialysis: membranes for dialysis, applications, liquid membranes: aspects, liquid membrane development, choice of the organic solvent and carrier, applications, introduction to membrane reactors.

#### UNIT- V

Polarization phenomenon and fouling: Introduction to concentration polarization, turbulence promoters, pressure drop, gel layer model osmotic pressure model, boundary layer resistance model, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling, compaction. Module and process design: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

## **Text Books:**

- 1. Membrane Separations, M.H.V. Mulder, Springer Publications, 2007
- 2. Rate-Controlled Separations, P. C. Wanket, Elsevier AppliedScience, London, 1994.

L T P C 3 0 0 3

B.Tech.(Reg), w.e.f. 2019-20 Academic Year

#### **Reference Books:**

- 1. Membrane Technology in the Chemical Industry, S.P. Nunes, K.V. Peinemann, Wiley-VCH
- 2. Membrane Processes in Separation and Purification, J.G.Crespo, K.W.Bodekes, Kluwer Academic Publications.
- 3. Membrane Separation Processes, K. Nath, PHI Pvt. Ltd., New Delhi, 2008.

#### **Course Outcomes:**

- 1. Explain various types of membranes and preparation techniques.
- 2. Understand the characterization and transport in membranes.
- 3. Understand the underlined principles and importance of ultrafiltration, reverse osmosis, electro dialysis, nano filtration etc., in industrial waste water treatment.
- 4. Learn gas separation in porous and non-porous membranes.
- 5. Design membranes for intended application

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year **PROCESS INTENSIFICATION** (Professional Elective – VI)

IV Year B.Tech. II-Sem

L T P C 3 0 0 3

Pre Requisites: Process heat transfer, Mass Transfer-I, Mass Transfer-II

## **Course Objectives:**

- 1. Explain the concept of Process Intensification.
- 2. Define the limitations of intensification for the chemical processes.
- 3. Describe the techniques of intensification to a range of chemical processes.

#### UNIT- I

**Introduction to Process Intensification(PI)**: sustainability-relatedissues in process industry, definitions of Process Intensification, fundamental principles and techniques of PI, the original ICI PI strategy, benefits of PI and obstacles to PI issues in designing of a sustainable, inherently safer processing plant

## UNIT-II

**PI Approaches**: STRUCTURE - PI approach in spatial domain, ENERGY - PI approach in thermodynamic domain, SYNERGY - PI approach in functional domain and TIME - PI approach in temporal domain

Mechanisms involved in PI: Mechanisms of intensified heat transfer, mass transfer, electrically enhanced processes, microfluidics

## UNIT-III

Application of PI techniques to heat transfer: Compact & micro heatexchangers

**Application of PI techniques to reactors**: Spinning disc reactors, oscillatory baffled reactors (OBR), Rotating reactors, Micro reactors, membrane reactors, micro reactors, Reactive separation/ super critical operation and other intensified reactor types.

#### UNIT-IV

Intensification of Separation Processes: Distillation, Centrifuges, membranes, drying, precipitation and crystallization

Intensified Mixing: Inline mixers, mixing on spinning disk, inductionheated mixer

## UNIT-V

**Application areas of PI**: Petrochemicals and Fine Chemicals: Refineries, Bulk Chemicals, Fine Chemicals, Fine Chemicals and Pharmaceuticals, bio processingOffshore Processing, Nuclear Industries, Food and drink water sector, Textiles, Aerospace, biotechnology

#### **Text Books:**

1David Reay, Colin Ramshaw, Adam Harvey, Process Intensification-Reengineering for efficiency, sustainability and flexibility, Butterworth Heinemann, (Elsevier)2008.

2.Stankiewicz, A. and Moulijn, (Eds.), Reengineering the Chemical Process Plants, Process Intensification, marcel dekker 2003

**Reference Books:** 

## Dept. of CHEM./JNTUHCEH B.Tech.(Reg), w.e.f. 2019-20 Academic Year

- 1. Frerich Johannes Keil, Modeling of process intensification, Wiley 2007
- 2. Juan Gabriel Segovia Hernandez, Andrian Bonilla-Petericiolet, Process Intensification in Chemical Engineering: Design optimization and control, Springer 2016.

## **Course Outcomes:**

- 1. Be familiar with process intensification in industrial processes.
- 2. Assess the valuesand limitations of process intensification, cleaner technologies and waste minimization options.
- 3. Measure and monitor the usage of raw materials and wastes generating from production and frame the strategies for reduction, reuse and recycle.
- 4. Process challenges using intensification techniques.
- 5. Describe the applications of process intensification in various chemical industries.

# B.Tech.(Reg), w.e.f. 2019-20 Academic Year **MAJOR PROJECT (PHASE-II)**

## LTPC

# IV Year B.Tech. II-Sem

000 8

# Pre Requisites: NIL

# **Course Objectives:**

- 1. Explain about the proposed problem in the relevant field with more details.
- 2. Describe the solution for the proposed problem effectively.
- 3. Improve them in solving various problems in the relevant field similar to their problem.

## **Course Outcomes:**

- 1. Explain the various simulation methods or process techniques involved in solving the problem.
- 2. Interpret the results and explain them elaborately with effective techniques.
- 3. Explain in detail the duration and time-plan for solving the problem.
- 4. Analyse the results by comparing with results from literature.
- 5. Prepare the project report in well-defined manner.