w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 1st YEAR SYLLABUS (w.e.f AY 2018-19)

CHEMICAL ENGINEEERING

I Year I Semester

S.No	Category	Course Title	Hours per week			Credits
			L	T	P	
1	BSC	Engineering Mathematics	3	1	0	4
2	BSC	Engineering Physics	3	1	0	4
3	ESC	Programming for Problem Solving	3	0	0	3
4	ESC	Engineering Graphics	1	0	4	3
5	BSC	Engineering Physics Lab	0	0	3	1.5
6	ESC	Programming for Problem Solving Lab	0	0	3	1.5
		Total Credits				**17**

I Year II Semester

S.No	Category	Course Title	Hours per week			Credits
			L	T	P	
1	BSC	Applied Mathematics	3	1	0	4
2	BSC	Engineering Chemistry	3	1	0	4
3	ESC	Engineering Mechanics	3	1	0	4
4	HSMC	English	2	0	0	2
5	BSC	Chemistry Lab	0	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				**19**

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 2nd YEAR SYLLABUS (w.e.f AY 2018-19)

CHEMICAL ENGINEEERING

II YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	BSC	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	3	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				**21**

II YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PCC	Chemical Engineering Thermodynamics-I	3	0	0	3
2	ESC	BEE	3	1	0	4
3	HSMC	Fundamentals of Management For Engineers	3	0	0	3
4	PCC	Process Heat Transfer	3	1	0	4
5	BSC	Organic Chemistry	3	1	0	4
6	ESC	BEE Lab	0	0	2	1
7	BSC	Chemical Technology and Organic Synthesis Lab	0	0	2	1
8	PCC	Process Heat Transfer Lab	0	0	2	1
		Total Credits				**21**

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 3rd YEAR SYLLABUS (w.e.f AY 2018-19)

CHEMICAL ENGINEEERING

III YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PE-I	**Professional Elective – I** i) Petroleum Refining and Petrochemicals ii)Numerical Methods in Chemical Engineering iii)Interfacial and Colloidal Science	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	3	1	0	4
5	PCC	Chemical Engineering Thermodynamics-II	3	0	0	3
6	HSMC	Advanced English Communications Lab	0	0	2	1
7	PCC	Mass Transfer Operations Lab-I	0	0	3	1.5
8	PCC	Instrumentation and Process Control Lab	0	0	3	1.5
		Total Credits				**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	OE-I	**Open Elective – I** i) Solid Waste Management ii) Basics of Nanotechnology	3	0	0	3
2	PE-II	**Professional Elective – II** i) Materials Science ii) Renewable Energy iii) Fluidization Engineering	3	0	0	3
3	PCC	Process Modeling and Simulation	3	1	0	4
4	PCC	Mass Transfer Operations-II	3	1	0	4
5	PCC	Chemical Reaction Engineering-II	3	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 / Essence of Indian Traditional Knowledge	2	0	0	0
		Total Credits				**22**

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

w.e.f. 2018-2019 academic year

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. 4th YEAR SYLLABUS (w.e.f AY 2018-19)

CHEMICAL ENGINEEERING

IV YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	OE - II	**Open Elective – II** i)Industrial Pollution Control Engineering ii)Design and Analysis of Experiments	3	0	0	3
2	PE-III	**Professional Elective – III** i)Biochemical Engineering ii) Corrosion Engineering iii)Water Conservation and Management	3	0	0	3
3	PE-IV	**Professional Elective - IV** i)Polymer Science and Engineering ii) Computational Fluid Dynamics iii)Nuclear Engineering	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		Major Project (Phase-I)				3
		Total Credits				**21**

IV YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	OE - III	**Open Elective – III** i)Industrial Safety and Hazard Management ii) Energy Engineering	3	0	0	3
2	PE-V	**Professional Elective – V** i) Optimization Methods ii)Technology of Pharmaceuticals and fine chemicals iii)Fuel Cell Technology	3	0	0	3
3	PE-VI	**Professional Elective – VI** i) Food Processing Technology ii)Membrane Technology iii)Process Intensification	3	0	0	3
4		Major Project (Phase-II)				8
		Total Credits				**17**

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

MATHEMATICS - I

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

ENGINEERING PHYSICS

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

PROGRAMMING FOR PROBLEM SOLVING

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

ENGINEERING MECHANICS

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

PROGRAMMING FOR PROBLEM SOLVING LAB

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

ENGINEERING PHYSICS LAB

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

MATHEMATICS - II

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

CHEMISTRY – I

(CONCEPTS OF CHEMISTRY FOR ENGINEERING)

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	1	**0**	**4**	**3**

ENGINEERING GRAPHICS AND DESIGN

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	1	**0**	**3**	**2.5**

ENGINEERING WORKSHOP

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	2	**0**	**0**	**2**

ENGLISH

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

ENGINEERING CHEMISTRY LAB

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

I B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

ENGLISH COMMUNICATION LAB

Pre Requisites: NIL

Objectives:

Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	1	0	4

MATHEMATICS - III

Pre Requisites:

Course Objectives:

Course Outcomes:

To be obtained from **Mathematics Department**

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

MATERIAL AND ENERGY BALANCE COMPUTATIONS

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, Non volatile 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

TEXTBOOKS:

1. Chemical process principles, Part -I, Material and Energy Balance, Hougen O A, Watson K.M. and Ragatz R.A. 2nd 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
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd 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 elementary flow-sheeting, material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge.
5. Develop mastery over process calculations relevant to chemical engineering processes

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	1	0	4

CHEMICAL ENGINEERING FLUID MECHANICS

Pre Requisites: NIL

Course Objectives:

1. To apply the mechanics of fluids (fluid statics and fluid dynamics), relevant to Chemical Engineering operations.
2. To identify forces on fluids, hydrostatic forces on submerged bodies involving mass and momentum balances, Bernoulli equation, flow through pipes and ducts, flow measurement and instruments, flow transportation - pumps, blowers and compressors, conservation of mass, viscous flows, skin and form friction, lubrication approximation, potential flows and boundary layer theory.
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.

Fluid flow phenomena-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 π 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, 7th ed, 2007
2. Chemical Engineering Fluid Mechanics by Ron Darby, CRC Press, 2nd 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, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

Course Outcomes:

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

1. Illustrate by simplification of equations of motion in simple 1-D flows
2. Calculate Boundary layer thicknesses, 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

PHYSICAL AND ANALYTICAL CHEMISTRY

Pre Requisites:

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 analyse 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's theory-Kinetics of Photochemical reactions: Chain reactions and their characteristics. Steady state treatment – dissociation of HI, reaction between H_2 & Br_2 and H_2 & O_2

UNIT II

Colloids & Surface chemistry: Colloids: Classification of colloids- preparation & 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: Concept of adsorption, factors influencing adsorption-Adsorption isotherms – Freundlich, Langmuir- B.E.T theory of adsorption. Determination of surface area using B.E.T method. Adsorption of gases on solids – physisorption and chemisorptions, Applications of adsorption.

UNIT III

Chromatography: Column chromatography-Principle-terminologyretention time, retention volume, RF value. Thinlayer chromatography-identification of spots by spraying and other methods; Gas Chromatography: Principle of Gas Chromatography block diagram of gas chromatograph- Functions of each component, Detectors- (FID, ECD)-stationary phase for column, mobile phase, chromatogram, qualitative analysis, quantitative analysis, retention time, retention volume, capacity factor, area normalization method; HPLC: Principles of high performance liquid chromatography, Block diagram of HPLC- 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: base peak and applications of Mass Spectroscopy.

UNIT V

Gravimeric and Thermal Analysis:

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

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

Course Outcomes:

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

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 Arun Bahl, S.Chand and Company Ltd.,

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

MECHANICAL OPERATIONS

Pre Requisites: NIL

Course Objectives:

1. To describe the numerous industrial operations dealing with the particulate solids, their handling in various unit operations, and those in which particle- fluid interactions are important.
2. To explain fluid-particle mechanics, such as the notion of drag, and builds on those fundamentals to develop design concepts for various industrial processes like packed bed operation, fluidized operations, sedimentation, filtration, separation of solids and fluids, etc. Industrial applications are discussed.
3. To explain the methods of separations based on motion of a particle through fluids.

UNIT I

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's law. 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 ultra filtration, concentration polarization, particle rejection of solutes, micro filtration, electrostatic separation,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 7th edn. 2001.

REFERENCE BOOKS:

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

Course Outcomes:

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

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. Calculate pressure drop in fixed and fluidized beds
5. Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
0	0	2	1

FLUID MECHANICS LAB

Pre Requisites: Fluid Mechanics

Course Objectives:

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

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
0	0	3	1.5

PHYSICAL AND ANALYTICAL CHEMISTRY LAB

1. To determine the partition coefficient value by studying the adsorption of acetic acid on animal charcoal.
2. Chemical kinetics: Study of first order kinetics of Acid catalysed hydrolysis of Methyl aeate.
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
8. Determination of sulphates through turbidometry.
9. Assay of paracetamol / ibuprofen sample using spectrophotometer.
10. Redox titrations by potentiometry. Estimation of Ferrous.

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester

L	T	P	C
0	0	3	1.5

MECHANICAL OPERATIONS LAB

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 the thickener 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. Verification of Stoke's Law.
4. Size reduction of the given material using Jaw Crusher and determine the reduction ratio.
5. Size reduction of the given material using Roll Crusher and verification of comminution laws.
6. Size reduction of the given material using Ball Mill and determine the reduction ratio.
7. Calculate the thickener area from the batch sedimentation process under the given conditions.
8. Determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
9. Calculate the separation efficiency of particles in a mixture using cyclone separator.
10. Determination of recovery percentage of the concentrate by Froth- Floatation process.

Course Outcomes:

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

1. Pick or take a representative amount of sample and conduct sieve analysis.
2. Determine the reduction ratio in crushing and grinding of different materials using various 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	2	**0**	**0**	**0**

ENVIRONMENTAL SCIENCE

Pre Requisites: NIL

Course Objectives:

Course Outcomes:

To be obtained from Other Department.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

CHEMICAL ENGINEERING THERMODYNAMICS – I

Pre Requisites: NIL

Course Objectives:

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 give 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, 7th ed, McGraw Hill,2005
2. Chemical Engineering Thermodynamics by 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

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

BASIC ELECTRICAL ENGINEERING

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 AND 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 Mc Graw Hill, 2010.
2. S.L. Uppal and G C Garg' Electrical Wiring Estimating & Costing', Khanna Publihers 6th edition, 1987.

REFERENCE BOOKS:

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

Course Outcomes:

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

1. Analyze and solve electrical circuits using network laws and theorems.
2. Understand and analyze basic Electric and Magnetic circuits
3. Study the working principles of Electrical Machines.
4. Introduce components of Low Voltage Electrical Installations

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

Pre Requisites:

Course Objectives:

Course Outcomes:

To be obtained from **HSMC Department**

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

PROCESS HEAT TRANSFER

Pre Requisites: NIL

Course Objectives:

1. To distinguish different 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 and forced convection, radiation.

Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres. Unsteady state heat conduction: Equation for one-dimensional conduction, 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 heat transfer 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 and horizontal planes, effect of natural convection in laminar-flow heat transfer.

Heat transfer to fluids with phase change: Heat transfer from condensing 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 semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT V

Heat exchange equipment: General design of heat exchange equipment, 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, capacity and economy, multiple effect evaporators, methods of feeding, vapor recompression.

TEXT BOOKS:

1. Unit Operations of Chemical Engineering, 6th 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, Heat Transfer, 10th Ed., Tata McGraw-Hill (2011).
2. Chemical Engineering, Volume-I, J. Coulson and R.F. Richardson, Pergamon Press.

Course Outcomes:

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

1. State fundamentals of heat transfer and identify principles of different modes of heat transfer
2. Design, analyze heat transfer equipment , compare performances and select type of heat transfer equipment
3. Demonstrate industrial applications of heat exchangers
4. Apply the principle of heat transfer in heat exchanger design.
5. Illustrate the principles of evaporation and evaporator design.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

ORGANIC CHEMISTRY

Pre Requisites:

Course Objectives:

The fundamental basic mechanisms of various types of Chemical reactions and isomerism are necessary to understand the procedures of synthetic techniques. 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, antifungbal, 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.

Course Outcomes:

A student will get a complete information about the mechanism of various reactions which are helpful for the designing of drugs. The student also learn about the green methods for the synthesis. A good knowledge of dyes and properties of Heterocyclic Chemistry is gained.

TEXT BOOKS

1. Text book of Organic Chemistry – Morrison and Boyd.
2. Medicinal Chemistry by Ashutosh Khar , New Age Publications.

REFERENCE BOOKS.

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	2	1

BASIC ELECTRICAL ENGINEERING LAB

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 AND 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.

List of Laboratory 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

Course Outcomes:

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

1. Analyze and solve electrical circuits using network laws and theorems.
2. Understand and analyze basic Electric and Magnetic circuits
3. Study the working principles of Electrical Machines.
4. Introduce components of Low Voltage Electrical Installations

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	2	1

CHEMICAL TECHNOLOGY AND ORGANIC SYNTHESIS LAB

List of Experiments:

1. Determination of Acid value of linsed and bgrounet oil
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 bluechip powder
6. Estimation of glucose
7. Estimation of total cellulose in saw dust
8. Preparation of soap
9. Preparation o f 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 styryl benzimidazole
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 Organic Manual Manual -R.K. Bansal

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

II B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	2	1

PROCESS HEAT TRANSFER LAB

Pre Requisites: Process Heat Transfer

Course Objectives:

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.

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

PETROLEUM REFINING AND PETROCHEMICALS
(Professional Elective – I)

Pre Requisites: NIL

Course Objectives:

1. To collect data on 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:

1. Nelson. W.L. “Petroleum refining Engineering”, 4th Edition, Mc Graw Hill, New York, 1969.
2. Rao, B.K.B. “Modern Petroleum Refining Processes”, 4th Edition, Oxford and IBH Publishing, 2002.

REFERENCE BOOKS:

1. Goldstine. R.F. “The Petroleum Chemicals Industry”, Taylor and Francis, London, 1967.
2. Gruese. W.S.and Stevens, D.R. “Chemical Technology of Petroleum”, McGraw Hill, 1980.
3. Chauvel. A. and Lefevrev, “Petro Chemicals”, Volume 1 and 2, Gulf Publishing company 1989.

Course Outcomes:

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

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. Study the technologies of low carbon alkane and alkynes based high value chemicals.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

NUMERICAL METHODS IN CHEMICAL ENGINEERING
(Professional Elective – I)

Pre Requisite: M-I, M-II

Course Objectives:

1. To introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming.
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. Chemical engineering problems involving solution of linear and No-linear algebraic equations.

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

Numerical Integration: Trapezoidal rule, Simpson's rule, integration with unequal segments, Chemical engineering problems involving numerical differentiation and integration.

UNIT IV

Solution of ordinary Differential Equations- Introduction to ordinary Differential Equations, Euler method, Runge-Kutta 4^{th} order method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs.

UNIT V

Solution of Partial Differential Equations: elliptic, parabolic and hyperbolic equations. Finite difference methods, Leibman's method, Crank Nicholson method. Apllications 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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

INTERFACIAL AND COLLOIDAL SCIENCE
(Professional Elective – I)

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, Vanderwalls Forces.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.

w.e.f. 2018-2019 academic year

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, 2nd 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, 6th edition, A. Adamson, 1997.
3. Colloid and Interface Science by Pallab Ghosh, PHI, New Delhi.

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	1	0	4

MASS TRANSFER OPERATIONS-I

Pre Requisites: NIL

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, inter-phase 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.

UNIT-V

Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, ΔL law, crystallization equipment including MSMPR crystallizers.

TEXT BOOKS:

1. R.E.Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill, New Delhi, 1983.
2. Binay K.Dutta, Principles of Mass Transfer and Separation Processes,2nd edition, Prentice Hall of India,2007.

REFERENCE BOOKS:

1. C.J. Geankoplis, Transport Processes and Separation Process Principles, 4th Edition, Pearson Education 2015.

Course Outcomes:

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

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. Know the principles of humidification and dehumidification, design the cooling towers
5. Drying mechanism and principles of crystallization

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	1	0	4

CHEMICAL REACTION ENGINEERING-I

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 chemical reactor, 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

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, irreversible trimolecular type third 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, second order 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^{th} 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 reaction from 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, 3rd ed., O. Levenspiel, John Wiely & Sons, 1999.

REFERENCE BOOKS:

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

Course Outcomes:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	1	0	4

INSTRUMENTATION AND PROCESS CONTROL

Pre Requisites: 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. Draw the 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, 2nd 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:

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

1. Illustrate the various 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

CHEMICAL ENGINEERING THERMODYNAMICS-II

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, 7th ed., J.M. Smith, H.C. Van Ness and M.M. Abbott, Tata McGraw-Hill, New Delhi, 2015.

REFERENCE BOOKS:

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

Course Outcomes:

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

1. Explain in detail about solution 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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

ADVANCED ENGLISH COMMUNICATIONS LAB

Pre Requisites: NIL

Course Objectives:

Course Outcomes:

To be obtained from **English Department**

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
0	0	3	1.5

MASS TRANSFER OPERATIONS LAB – I

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. Calculate 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:

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

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. Compute the mass transfer coefficient for any given system.
5. Calculate the characteristic curves in a batch drying.
6. Interpret the data and prepare formal lab reports describing the obtained experimental results.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. I-Semester

L	T	P	C
0	0	3	1.5

INSTRUMENTATION AND PROCESS CONTROL LAB

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

1.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

2. 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

5. 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.

w.e.f. 2018-2019 academic year

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

OPEN ELECTIVE – I
SOLID WASTE MANAGEMENT

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

BASICS OF NANOTECHNOLOGY
(Open Elective – I)

Pre Requisites: NIL

Course Objectives:

1. Discuss about the basics of nanotechnology
2. Classify and explain the various properties of nanomaterials
3. Describe the various methods for synthesis of nanomaterials and their applications

UNIT I

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

UNIT II

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline 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 Nanopowders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Applications of Nanomaterials: 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:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

MATERIALS SCIENCE
(Professional Elective – II)

Pre Requisites: NIL

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.

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_3 C, Pb-Sn , Cu-Ni systems.

Phase transformations in Fe-Fe_3C 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, 5th ed. V. Raghavan, PHI Learning Pvt. Ltd., New Delhi, 2009.

REFERENCE BOOKS:

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

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

RENEWABLE ENERGY
(Professional Elective – II)

Pre Requisites: NIL

Course Objectives:

1. Understand the various forms of conventional energy resources.
2. Learn 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 green house- 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.

TEXT BOOKS:

1. Rai. G.D. "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
2. Sukhatme.. S.P. "Solar Energ", 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:

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

1. Describe the need of 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. Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

FLUIDIZATION ENGINEERING
(Professional Elective – II)

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.

w.e.f. 2018-2019 academic year

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.

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:

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

1. Illustrate the fluidization phenomena and operational regimes.
2. Explain the minimum 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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

PROCESS MODELING AND SIMULATION

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

Examples of mathematical models of chemical engineering systems: Series of isothermal constant hold-up CSTRs, CSTRs with variable hold-ups, two heated tanks, gas phase pressurized CSTR, Non-isothermal CSTR

UNIT III

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

UNIT IV

Empirical model building- method of least squares, linear, polynomial and multiple regression, non-Linear regression

Process Simulation examples: VLE dew point and bubble point calculations, 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 Vs Design mode, sequential modular approach, Simultaneous modular approach, Equation solving approach, Introduction to various simulation software packages in chemical engineering

TEXTBOOKS:

1. Process Modeling, Simulation and Control for Chemical Engineers, 2nd 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

Course Outcomes:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

MASS TRANSFER OPERATIONS-II

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 review 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- Ponchon Savarit Method, 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 curve and fixed bed adsorption. Equipment for adsorption (single stage and continuous contact), Ion exchange. Crystallization.

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.

TEXTBOOKS:

1. R.E.Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill, New Delhi, 1983.
2. Binay K.Dutta, Principles of Mass Transfer and Separation Processes,2nd edition, Prentice Hall of India,2007
3. W.L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, Tata McGraw Hill, India, 2014.

REFERENCE BOOKS:

1. C.J. Geankoplis, Transport Processes and Separation Process Principles, 4th Edition, Pearson Education 2015.

Course Outcomes:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	1	0	4

CHEMICAL REACTION ENGINEERING-II

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, the RTD, 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: The rate 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 core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Course Outcomes:

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

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. Describe the adsorption phenomena.
5. Design fluid-solid reactors.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	2	1

PROCESS SIMULATION LAB

Pre Requisites: Process Modeling and Simulation

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	3	1.5

MASS TRANSFER OPERATIONS LAB-II

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester

L	T	P	C
0	0	3	1.5

CHEMICAL REACTION ENGINEERING LAB

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

III B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	2	**0**	**0**	**0**

INDIAN CONSTITUTION / ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Pre Requisites: NIL

Course Objectives:

Course Outcomes:

To be obtained from HSMC Department

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

INDUSTRIAL POLLUTION CONTROL ENGINEERING
(Open Elective – II)

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-green house 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.

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.Prathap mouli and N.Venkata subbayya. 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

DESIGN AND ANALYSIS OF EXPERIMENTS
(Open Elective – II)

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^{nd} edn.,D.C.Montgomery, John Wiley and Sons, New York, 2003.

REFERENCE BOOKS:

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

Course Outcomes:

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

BIOCHEMICAL ENGINEERING
(Professional Elective – III)

Pre Requisites: NIL

Course Objectives:

1. To employ an application of chemical engineering principles in 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: 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: 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

Unstructed model for microbial growth: The development of different microbial growth kinetics like Malthus, Pearl and reed, Monad 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

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:

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

1. Relate stoichiometry and energetics of cell growth and product formation.
2. Design novel bioprocesses for their research in various areas.
3. Understand the purification of biological products
4. Illustrate the principles of biochemical engineering in analysis and design of industrial biochemical processes
5. Evaluate the kinetics of enzyme action in substrate and inhibitor.
6. Evaluate the kinetics and mechanism of microbial growth

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

CORROSION ENGINEERING
(Professional Elective – III)

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 chemical Environment.-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:

1. M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company.
2. 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 the corrosion and explain about its various forms.
2. Illustrate the various techniques to test 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

WATER CONSERVATION AND MANAGEMENT
(Professional Elective – III)

Pre Requisites: NIL

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, water storage, 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, Goen Ho, 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:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

POLYMER SCIENCE AND ENGINEERING
(Professional Elective – IV)

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.

w.e.f. 2018-2019 academic year

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

COMPUTATIONAL FLUID DYNAMICS
(Professional Elective – IV)

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:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

PROFESSIONAL ELECTIVE - IV
NUCLEAR ENGINEERING

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 energy

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.

Course Outcomes:

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

1. Summarize about the concepts of nuclear physics
2. List the reactor materials 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. List the various hazards and safety measures involved while handling the reactors.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

CHEMICAL PROCESS TECHNOLOGY AND ECONOMICS

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 aluminium sulphate 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, 5th edition 1985.
2. Dryden's outlines of Chemical Technology by M.Gopal Rao and M.Sittig, 2nd ed. 1973.
3. Plant Design and Economics for Chemical Engineering, 4th 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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester

L	T	P	C
3	0	0	3

TRANSPORT PHENOMENA

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., 2nd 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, 3rd ed. 1997.
3. Fundamental of heat, momentum and mass transfer, Welty, Wickson, Wilson, John Wiley.

Course Outcomes:

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

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

.

.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

INDUSTRY ORIENTED MINI PROJECT / INDUSTRIAL TRAINING

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

SEMINAR

Pre Requisites: NIL

Course Objectives:

Course Outcomes:

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. I-Semester	**L**	**T**	**P**	**C**
	-	**-**	**-**	**3**

MAJOR PROJECT (PHASE-I)

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

OPEN ELECTIVE – III
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

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:

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

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

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

ENERGY ENGINEERING
(Professional Elective – II)

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, 3rd 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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

OPTIMIZATION METHODS
(Professional Elective – V)

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.

REFERENCE BOOKS:

1. S.S.Rao, Engineering Optimization Theory and Practice, 3rd edition, New Age International Publishers, India.
2. K.Deo, Optimization techniques, Wiley Eastern, 1995.

Course Outcomes:

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

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. Learn linear programming and applications

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS
(Professional Elective – V)

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, 16th 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:

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

1. Understand the knowledge of base chemicals and drug intermediates.
2. .Describe the preparation and their properties of various pharmaceuticals and fine chemicals
3. Understand the principle of plant design in Pharmaceutical Industry.
4. Draw flow sheets for manufacture of pharmaceuticals and fine chemicals.
5. Understand tablet making and coating, preparation of capsules and extraction of crude drugs.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

FUEL CELL TECHNOLOGY
(Professional Elective – V)

Pre Requisites: NIL

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.

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.

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:

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

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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

FOOD PROCESSING TECHNOLOGY
(Professional Elective – VI)

Pre Requisites: Mechanical Operations, Fluid Mechanics, Process Heat Transfer

Course Objectives:

1. To impart knowledge to the students about food processing and various unit operations involved in it.
2. Learn various packaging, storing and preservation
3. Aim to learn difference between microwave and conventional heating.

UNIT I

Food process engineering - Fundamentals: Fundamentals of food process engineering, application of quantitative methods of material and energy balances in food engineering practices.

UNIT II

Unit Operations in food industries: Fluid flow, thermal process calculations, 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, Thermal Methods, 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. 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.
2. J. G. Bernnan, J. R. Butters, N. D. Cowell and A.E.V.Lilley, "Food Engineering Operations", 2nd Edn., Applied Science, 1976.
3. Fundamentals of Food Engineering, D G Rao, PHI, New Delhi, 2012.

Course Outcomes:

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

1. Understanding the various causes of food deterioration and food poisoning.
2. Identify appropriate processing, preservation, and packaging method.
3. Analyze product quality and effect of processing technique on it.
4. Compare microwave versus conventional heating.
5. Learn chemical unit operations in food processing.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

MEMBRANE TECHNOLOGY
(Professional Elective – VI)

Pre Requisites: NIL

Course Objectives:

1. Explain the basic principles of membrane separation processes.
2. Describe about the characterization of membrane.
3. Introduce the concepts of polarization, fouling, module and process design

UNIT I

Introduction: Separation process, Introduction to membrane processes, definition of a membrane, classifications membrane processes. 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, aracterization 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

Membrane Processes: Introduction, osmosis, pressure driven membrane 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 Applied Science, London,1994.

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:

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

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, electrodialysis, nano filtration etc., in industrial waste water treatment.
4. Learn gas separation in porous and non porous membranes.
5. Design membranes for intended application

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester

L	T	P	C
3	0	0	3

PROCESS INTENSIFICATION
(Professional Elective – VI)

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-related issues 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 heat exchangers

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, induction heated mixer

UNIT V

Application areas of PI: Petrochemicals and Fine Chemicals : Refineries, Bulk Chemicals, Fine Chemicals, Fine Chemicals and Pharmaceuticals, bio processing Offshore Processing, Nuclear Industries, Food and drink water sector, Textiles, Aerospace, biotechnology

TEXT BOOKS:

1 David 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:

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:

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

1. Be familiar with process intensification in industrial processes.
2. Assess the values and 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.

w.e.f. 2018-2019 academic year

JNTUH COLLEGE OF ENGINEERING HYDERABAD

IV B.Tech. Chem. Engg. II-Semester	**L**	**T**	**P**	**C**
	-	**-**	**-**	**8**

MAJOR PROJECT (PHASE-II)

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:

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

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. Analyze the results by comparing with results from literature.
5. Prepare the project report in well defined manner.