

## Chemical Engineering Thermodynamics-I, CHE202B

**Branch/ Semester : B.Tech- Chemical Engineering/ 4<sup>th</sup> Semester**

**Credits: 4**

**Objective:**The present course aims to introduce the principles of Chemical Engineering Thermodynamics and illustrate their application to design of chemical process plants. The content comprises the fundamental laws of thermodynamics, the estimation of volumetric and key thermodynamic properties of real fluids and mixtures, phase and chemical reaction equilibria, thermodynamics of flow processes and refrigeration & liquefaction

**Internal Assessment details:**

Minor-I-7.5 marks

Minor-II- 7.5 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

**Total Internal marks = 25 marks**

**Theory Exam = 75 marks**

**Total = 100 marks**

**Tentative lecture plan:**

Lecture No.	Topics Covered
1-8	<b>UNIT-1</b> -Basics of thermodynamics-enthalpy, equilibrium, phase rule, heat capacity, ideal gas, real gas, heat effects,P-V-T Behaviour of Pure Fluids, Virial equations, cubic equations, generalised correlations and acentric factor, behaviour of liquids.
9-13	<b>UNIT-2</b> Laws of Thermodynamics - Review, their applications to real processes, concept of entropy macroscopically and microscopically.
14-19	<b>UNIT 3</b> Thermodynamics of Flow Processes - Metering and throttling processes, thermodynamic analysis of flow through nozzles
20-26	<b>UNIT-3 cont.</b> Compression of gases in single as well as multistage compressors their volumetric and isentropic efficiencies.
27-32	<b>UNIT-4</b> Refrigeration & Liquefaction - Ideal refrigeration cycle, air, vapour compression and absorption refrigeration cycles, C.O.P., choice of refrigerants
33-37	<b>UNIT-4cont.</b> Liquefaction processes and estimation of minimum work requirements

**TEXT BOOKS:**

1. A Textbook of Chemical Engineering Thermodynamics: K. V. Narayanan- PHI Learning Pvt. Ltd.
2. Introduction to Chemical Engineering Thermodynamics: J .M. Smith and H.C. Van Ness - McGraw-Hill Book

**REFERENCE BOOKS:**

1. Chemical and Process Thermodynamics: B.G. Kyle - Prentice Hall of India Pvt. Ltd., New Delhi.
2. Chemical Engineering Thermodynamics: T.E. Daubert - McGraw Hill, New Delhi.

## Mechanical Operation, CHE204 B

**Branch/ Semester : B.Tech- Chemical Engineering/ 4<sup>th</sup> Semester**

**Credits : 5**

**Objective :** In chemical engineering , Mechanical operations are basic step in a process. Mechanical operations involve various unit operations such as Size reduction, separation, crystallization, filtration, transportation. Every chemical process may require many various unit operations to obtain the desired product from the starting materials, or feedstocks.

**InternalAssesment details:**

Minor-I-15 marks

Minor-II- 15 marks

Assignments: 10 marks

Surprise/Quiz Test:10 marks

**Total Internal marks = 50 marks**

**Final = 75 marks**

**Total = 125 marks**

**Tentative lesson plan:**

Lecture No.s	Topics Covered
1-10	Unit 1: Particle size and shape, Size and shape distributions, Measurement and analysis, Concept of average diameter; Size reduction, Laws of grinding; Agglomeration and compaction; Screening, Design of screens.
11-20	Unit 2: Flow around a single particle, Drag force and drag coefficient, Settling velocity of a particle in a fluid, Concept of relative velocity; Packed beds, Bed porosity, Flow through a bed of particles, Ergun's equation, Hindered & free settling of particles.
21-30	Unit 3: Filtration, principle of filtration and types of filters; Thickeners; Gravity separation; Cyclones.
30-40	Unit 4: Fluidised beds and transport of particles; Storage of Solids, Flow of solids by gravity, Transport of solids by screw/ belt conveyors; Bag filters, Electrostatic precipitators, Elutriation, Particle collection systems, Mixing & agitation

**TEXT BOOKS:**

1. "Chemical Engineering", J.M. Coulson & J.F. Richardson Vol. II, Pergamon Press.
2. "Unit Operations", G.G. Brown, Asia Publishing House.

**REFERENCE BOOKS:**

- 1 Principles of Unit Operations", A.S. Foust et al., John Wiley
- .2. "Unit Operations of Chemical Engineering", W.L.McCabe & J.C.Smith, McGraw Hill.
- 3."Mechanical Operations for Chemical Engineers", B.C.Bhattacharya & C.M. Narayanan, Khanna Publishers.

## Material Technology, CHE 206B

**Branch/ Semester : B.Tech- Chemical Engineering/4<sup>th</sup> Semester**

**Credits: 5**

**Objective:** This subject deals with the detailed study of Mechanical properties of various materials and Factors affecting the selection of material for constructional purposes in chemical industries.

**Internal assessment details:**

Minor-1: 15 Marks

Minor-2: 15 Marks

Assignment/ performance in class: 10Marks

Surprise Quiz/ Tutorial: 10 Marks

Total Internal Marks-50Marks

Final Examination-75 Marks

Total-125Marks

**Tentative lesson plan:**

Lecture no.	Topic covered
1-5:	Factors affecting the selection of material for constructional purposes in chemical industries, Metallic and Non-Metallic materials of construction.
6-10:	Ferrous and Non-Ferrous metals. Corrosion, Various types, Mechanism, Methods of prevention and control.
11-15:	Mechanical properties of various materials, Various modes of deformation, Crystal defects, Cold and hot working of metals and their effects on mechanical properties, Structure of solid phases, Different types of structure B.C.C., F.C.C. and H.C.P.
16-20:	Binary equilibria involving solid solution, Eutectic and peritectic systems, Cu-Ni, Cu-Zn, Fe-C diagrams, Heat treatment, General principles, TTT-curves, Annealing, normalizing, hardening, tempering and age hardening.
21-25	Ferrous Metals, Grey and white cast iron, Malleable, Mechanite and nodular cast iron, Plain Carbon Steels: Classification, properties and applications, Alloy Steels: Stainless steels, ferritic, austenitic and martensitic, applications of stainless steels in chemical industries.
26-30	Alloy tool steels, ultra high strength steels, cryogenic steel, bearing Metals (Babbitt), Heat resisting alloys. Non-Ferrous metals, Copper Brass, Bronze, Aluminum and their mechanical properties, Workability and applications.
31-35	Non-Metallic materials of construction: (a) Ceramics: Various types, Specialty glasses and refractory, properties and applications.
36-40	(b) Polymers: Classifications, Comparison and properties of various polymers and their relationship with chain structure, some application in chemical industries.

**TEXT BOOKS:**

1. "Material Science & Engineering", V.Raghvan, Prentice Hall.
2. "Engineering Materials: Properties & Selection", Budinski, Prentice Hall (V Edition)
3. Material Science & Engineering : K M Gupta , Umesh Publications

## Mechanical Operations Lab (CHE – 208B)

**Branch/ Semester : B.Tech- Chemical Engineering/4<sup>th</sup> Semester**

**Credits: 1.5**

### **Course Description and Objective:**

To conduct experiments related to power calculations in equipments involving size reduction; screening effectiveness; filtration; fluidization.

### **Lab plan:**

<b>Lab</b>	<b>Topics</b>
1.	Settling of single particle
2.	Sedimentation
3.	Size reduction by Jaw Crusher & Pulverizer
4.	Grinding in a Ball Mill
5.	Screen analysis
6.	Separation of dust particles from air
7.	Determination of pressure drop across a fluidized bed and a packed bed
8.	Filtration of slurry

### **Text Books:**

1. "Chemical Engineering", J.M. Coulson & J.F. Richardson Vol. II, Pergamum Press.
2. "Unit Operations", G.G. Brown, Asia Publishing House.

### **Reference Books:**

1. "Principles of Unit Operations", A.S. Foust et al., John Wiley.
2. "Unit Operations of Chemical Engineering", W.L.McCabe & J.C.Smith, McGraw Hill.
3. "Mechanical Operations for Chemical Engineers", B.C.Bhattacharya & C.M. Narayanan, Khanna Publishers.

### **Note:**

At least six experiments are to be performed out of above mentioned experiments.

### **Evaluation scheme (available in B.Tech. Ordinance):**

- Internal marks = 40

<u>Component</u>	<u>Weightage</u>
Viva-Voce/ Test	30%
Laboratory Record/Project Report/Seminar	40%
Objective Tests/Multiple Choice Questions	30%
- External marks = 60
- Total marks = 100

### **Attendance record:**

Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.

## Chemical Reaction Engineering – II (CHE – 302B)

Branch/ Semester : B.Tech- Chemical Engineering/6<sup>th</sup> Semester

Credits = 4

**Course Objective:** Main objective of this course is to teach the students about heterogeneous catalytic reactors and concepts related to non ideality and use of non ideality information in reactor design will be studied. Successful design of reactors requires understanding of chemical kinetics as well as physical processes as mass and energy transport.

### Lecture Plan:

Unit	Topics	Lectures
Unit – I	Introduction to catalysis, classification of catalysts, preparation and physical characteristics of solid catalysts, Concepts of physical adsorption and chemisorption	7
Unit – II	Kinetics of solid catalysed gas phase reactions, Power law and langmuir hinshelwood rate equations and parameter estimation	6
Unit – III	Diffusion of mass and heat in porous solids with and without external diffusional resistances, Effectiveness factor	7
Unit – IV	Fixed bed catalytic reactors; single and multibed adiabatic reactors, multitubular fixed bed reactors. Design equations for fixed bed reactors using pseudohomogeneous one and two-dimensional models	7
Unit – V	Concepts of heterogeneous models. Parametric sensitivity. Modelling of gas-solid non-catalytic reactions and determination of parameters	6
Unit – VI	Fluid-fluid reaction modelling based on film and penetration theory. Enhancement factors. Reactor system and design for gas-liquid and gas-solid non-catalytic systems	7

**Note:** Eight questions are to be set by taking at least one question from each unit but not more than two from any unit. Students have to attempt five questions in all.

### Text Books:

1. Chemical Reaction Engineering: Octave Levenspiel-Wiley Eastern Limited, New Delhi.
2. Elements of Chemical Reaction Engineering: H.Scott Fogler-Prentice-Hall of India Pvt. Ltd., New Delhi.

### Reference Books:

1. Kinetics and Mechanisms of Chemical Transformation: J.Rajaram and J.C.Kuriacose-Macmillan India Ltd.New Delhi.
2. Chemical Engineering Kinetics: J.M.Smith-Mcgraw-Hill Book company, New Delhi.

### Evaluation scheme (available in B.Tech. Ordinance):

- Internal marks = 25

Component	Weightage
Minor test-I	30%
Minor test-II	30%
Assignment / class performance	20%
Surprise quiz / tutorial tests (2+2)	20%
- External marks = 75
- Total marks = 100

## Chemical Technology -II , CHE304B

Branch/ Semester : B.Tech- Chemical Engineering/6<sup>th</sup> Semester

Credits : 4

**Objective :** This subject deals with the comprehensive study of the different chemical industries involving process technology, availability of raw materials, production trends, preparation of flow sheet, engineering problems involving material of construction, environmental pollution, waste utilization, economic aspects etc. The main objective is to familiarize the students with the basic concepts involved in manufacturing process of various industrial gasses, glass, cement, paint, paper & pulp, Leather industries etc. and to show students a comprehensive picture of chemical industries.

### Internal Assessment details:

Minor-I-15 marks

Minor-II- 15 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

**Total Internal marks = 25 marks**

**Final = 75 marks**

**Total = 100 marks**

### Tentative lesson plan:

Lecture No.s	Topics Covered
1-10	Unit 1: : Pulp and paper : Pulping processes, recovery of chemicals,stock preparation and paper making.Coal Chemicals : Coal for distillation and recovery of chemicals,feed stock, product profile. Petrochemicals : An Overview, ethylene oxide, ethylene,glycol,acrylonitrile, styrene, butadiene
11-22	Unit 2: : Leather Industry- Leather chemistry, manufacturing processes,and uses of leather,Food Industries : Food processing, food additives, oil & Fats : Soap & detergents,glycerin, waxes
23-30	Unit 3: Agrochemical Industries:Insecticides, herbicides,Pesticides, Surface-coating Industries : Paints, pigments, varnishes, lacquers. sugar & Starch : Sugar, starch and related products. Fermentation Industries : Alcohol, beer, wine, liquor, vinegar, citric acid, lactic acid.
31-40	Unit 4: Explosives & toxic chemicals: Nitrocellulose, nitroglycerine, TNT. Pharmaceutical Industries:Alkylation,carboxylation,acetylation,Dehydration,halogenation,oxidation,sulphonation, antibiotics, hormones, vitamins.

### TEXT BOOKS:

1. "Outlines of Chemical Technology", C.E. Dryden - East - West Press Pvt. Ltd., New Delhi.
2. "Shreve's Chemical Process Industries", G.T. Austin McGraw- Hill Book Company, New Delhi.

### REFERENCE BOOKS

1. "A text Book of Chemical Technology", S.D. Shukla and G.N. Pandey - Vol.-II Vikas Publishing House Pvt.Ltd., New Delhi.
2. "Industrial Chemical", W.L. Faith, D.B. Keyes and R.L. Clark - John Wiley.
3. "Chemical process industries", W.V.Mark, edited By S.C.Bhatia, vol. 2, edition 2:, CBS publisher & distributor, New Delhi.

## PROCESS UTILITIES, CHE-306 B

**Branch/ Semester : B.Tech- Chemical Engineering/6<sup>th</sup> Semester**

**Credits : 4**

**Objective:** This subject deals with reliable utility process for the successful operation in different fields of chemical engineering.

**Internal Assessment details:**

Minor-I-7.5 marks

Minor-II- 7.5 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

**Total Internal marks = 25 marks**

**Final = 75 marks**

**Total = 100 marks**

**Tentative lesson plan:**

Lecture No.s	Topics Covered
1-10	Unit 1: Heat Transfer Media-Characteristic properties, classification, selection & their industrial applications . Utilities, Refrigeration ,Steam System - Applications, design of efficient steam heating systems, condensate utilization and flash steam, steam Traps
11-20	Unit 2: Air, Reciprocating air compressors, vacuum pumps, air receivers, different types of ejectors and barometric condensers, piping networks for water, steam condensate and air Utilisation.
21-25	Water, its characteristics and conditioning for process industries, e.g. boiler feed, cooling etc. Recycling aspects of water
25-35	Hazards - Introduction, hazards due to fire explosion, toxicity and radiation, chemical hazards, maximum allowable concentration and threshold limiting values, protective and preventive measures in hazard control.
35-42	Unit 4: Disaster management - Scale of disaster, vapour cloud explosion, relief system emergency plans, standard safety programmes for disaster control, HAZOP analysis of plants. Indian legislation for safety and hazards, safety codes

**TEXT BOOKS:**

1. Chemical Process Safety Fundamentals with Applications: D.A. Crowl and J.F. Louvar - Prentice Hall.

**REFERENCE BOOKS:**

1. Loss Prevention in process Industry: F.P. Lees Vol I, II, III - Butterworths.
2. Safety in Process Design: G.C. Wells - John Wiley

## Mass Transfer-II, CHE308B

Branch / Semester : B.Tech- Chemical Engineering/6<sup>th</sup> Semester

Credits : 4

**Objective :** The main objectives of this course is to discuss the fundamental concepts of mass transfer operations and principles, and apply those concepts to real engineering problems. This course will provide an overview of mass transfer operations at basic to an intermediate level, and the coverage will be relatively broad.

### Internal Assessment details:

Minor-I-7.5 marks

Minor-II- 7.5 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

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**Total Internal marks = 25 marks**

**Final = 75 marks**

**Total = 100 marks**

### Tentative lesson plan:

Lecture No.s	Topics Covered
1-10	Distillation : Raoult's Law, ideal solutions, x-y and T-x-y diagrams, Flash vaporization and condensation, Batch distillation, Steam distillation, Azeotropes.
11-20	Binary distillation, McCabe Thiele and Ponchon_Savarit Method, Total reflux, Minimum and Optimum reflux ratios, Fenske equation, Multicomponent distillation.
21-30	Liquid-Liquid extraction : Application of liquid-liquid extraction, Liquid Equilibria, Equilateral-Triangular Coordinates, Systems of Three Liquids-One pair partially soluble, Systems of Three Liquids-Two pairs partially soluble, Choice of Solvent, Single stage extraction, Multistage extraction. Extraction Equipment
30-40	Leaching : Application of leaching, Moving-bed leaching, Dispersed-solid leaching, Single stage leaching, Multistage leaching. Leaching Equipment. Adsorption : Types of Adsorption, Adsorption Isotherms, Single stage adsorption, Multistage adsorption, Adsorption Equipment.

### TEXT BOOKS:

1. Mass Transfer Operations: R.E. Treybal-Mcgraw-Hill Book Company New Delhi.
2. Introduction to Chemical Engineering: W.L. Badger and J.T. Banchero-Mc-graw-Hill Book Company, New Delhi.

### REFERENCE BOOKS:

1. Unit Operations of Chemical Engineering: W.L. Mc Cabe & J.C. Smith- Mc-graw Hill, New Delhi.
2. Chemical Engineering: J.M. Coulson and J.F. Richardson Vol-I- Pergamon, New York.



## Transport Phenomena, CHE 310B

**Branch/ Semester:: B.tech-Chemical Engineering/6<sup>th</sup> Semester**

**Credits: 5**

**Objective:** This subject deals with the detailed study of momentum, heat and mass transfer and their inter correlation. Numerous examples are dealt in here with the help of shell balance approach.

**Internal assessment details:**

Minor-1: 15 Marks

Minor-2:15 Marks

Assignment/ performance in class: 10Marks

Surprise Quiz/ Tutorial: 10 Marks

Total Internal Marks-50Marks

Final Examination-75 Marks

Total-125Marks

**Tentative lesson plan:**

**Lecture no.**

**Topic covered**

- 1-5: Similarity between momentum, heat and mass transfer, the continuum hypothesis, Basic laws of fluid motion, Newton's second law of motion.
- 6-10: Principle of balance of momentum, Principle of conservation of energy, Newton's law of viscosity, Science of Rheology, Prediction of viscosity.
- 11-15: Boundary conditions, Shell balance approach for stress distribution and velocity profile, Equation of continuity and equation of motion and their application in fluid flow problems.
- 16-20: unsteady state momentum transport, Flow near a wall suddenly set in motion, Momentum transport phenomena in turbulent flows.
- 21-25 Fourier's law of heat conduction, Thermal conductivities, Boundary conditions, Shell balance approach for energy transfer problem, Heat sources, Principle of extended surface, Types of cooling fins.
- 26-30 free and forced convection, unsteady state heat transport, unsteady heat conduction in solids, heating of semi- infinite slab, heating of a finite slab.
- 31-35 Concentration, velocities and mass fluxes, Fick's law of diffusion, Boundary conditions, Shell balance approach for mass transfer problems
- 36-40 Problems of diffusion with chemical reaction in porous catalyst, the effectiveness factor, Equation of continuity for multicomponent mixtures.

**TEXT BOOKS:**

1. "Transport Phenomena", R.B.Bird, W.E. Stewart and E.N.Lightfoot, John Wiley & Sons.

## PROCESS EQUIPMENT DESIGN, CHE312B

Branch/ Semester:: B.tech-Chemical Engineering/6<sup>th</sup> Semester

Credits: 4

S. No.	Contents	No. of Lectures
1	Heat Exchanger- Auxiliary calculation, Review of Kern method	04
2	Bell's method and HTRI method of shell and tube heat exchanger	04
3	Design of Kettle, Thermosphonreboilers and their problems	04
4	Evaporators – sizing of drum, central core pipe size and Number of tubes	04
5	Evaporators – Short, long tube, design problem of evaporators	04
6	Solid – liquid extraction (Leaching) equipments and design problem	04
7	Design of Liquid – Liquid extraction and crystallizer equipments	04
8	Distillation column – Plate (Tray) column (sieve and valve) based on material balance	04
9	Distillation column – Plate (Tray) column (sieve and valve) based on Energy balance	04
10	Design of Packed column.	04
<b>Total Lectures</b>		<b>40</b>

## CHEMICAL TECHNOLOGY LAB, CHE314B

Branch/ Semester:: B.tech-Chemical Engineering/6<sup>th</sup> Semester

Credits: 1.5

Lab plan:

1. Estimation of calcium in lime stone.
2. Determination of percentage of available chlorine in a given sample of bleaching powder.
3. Determination of Potassium in a given sample of fertilizer by cobaltinitrite method OR by Flame photometry.
4. To estimate the percentage of sucrose in a given sample of cane sugar.
5. Estimation of non-reducing sugar.
6. To extract Caffeine from tea leaves.
7. To prepare fluorescein dye and Eosin dye.
8. To prepare soap.
9. To prepare urea formaldehyde resin.
10. To prepare cold cream.
11. To compare cleansing powers of two samples of detergent.
12. Determination of Tannin in fruit juice.

**Note:** At least 8 experiments are to be performed out of above mentioned experiments.

**Evaluation scheme (available in B.Tech. Ordinance):**

- Internal marks = 40

<u>Component</u>	<u>Weightage</u>
Viva-Voce/ Test	30%
Laboratory Record/Project Report/Seminar	40%
Objective Tests/Multiple Choice Questions	30%

- External marks = 60
- Total marks = 100

**Attendance record:**

Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.

## Mass Transfer – II Lab (CHE316B)

Branch/ Semester:: B.tech-Chemical Engineering/6<sup>th</sup> Semester

Credits: 1

### Course Description and Objective:

To conduct experiments related to separation processes for different states of feed.

### Lab plan:

Lab	Topics
9.	Batch distillation.
10.	Solid liquid extraction.
11.	Vapour liquid equilibrium.
12.	Liquid - Liquid extraction.
13.	Batch distillation with reflux.
14.	Adsorption isotherms.

### Text Books:

1. "Chemical Engineering", J.M. Coulson & J.F. Richardson Vol. II, Pergamum Press.
2. "Unit Operations", G.G. Brown, Asia Publishing House.
3. "Separation Processes", B.K.Dutta

### Reference Books:

1. "Principles of Unit Operations", A.S. Foust et al., John Wiley.
2. "Unit Operations of Chemical Engineering", W.L.McCabe & J.C.Smith, McGraw Hill.
3. "Mechanical Operations for Chemical Engineers", B.C.Bhattacharya & C.M. Narayanan, Khanna Publishers.

### Note:

At least six experiments are to be performed out of above mentioned experiments.

### Evaluation scheme (available in B.Tech. Ordinance):

- Credits = 1
  - Internal marks = 20
- | <u>Component</u>                          | <u>Weightage</u> |
|---|------------------|
| Viva-Voce/ Test                           | 30%              |
| Laboratory Record/Project Report/Seminar  | 40%              |
| Objective Tests/Multiple Choice Questions | 30%              |
- External marks = 30
  - Total marks = 50

### Attendance record:

Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.

## Chemical Reaction Engineering – II Lab(CHE – 318B)

Branch/ Semester:: B.tech-Chemical Engineering/6<sup>th</sup> Semester

Credits: 1.5

### Course Description and Objective:

Experiment are conducted for various reactors types i.e., batch reactor, plug flow reactor, continuous flow reactor, fluidized bed reactor. These reactors can be used individually or in combination with one another. This lab facilitates the students in understanding the kinetics of various reactions. Students can also compare the efficiency of various reactors for a particular reaction and can find out the appropriate reactor scheme for the reaction. Students can also study the RTD in various reactors.

### Lab plan:

Lab	Topics
15.	Adsorption isotherms
16.	Inversion of cane sugar
17.	Flow analogy for series and parallel reactions
18.	Rate constant of saponification reaction in PFR
19.	Rate constant of esterification reaction in batch reactor
20.	Rate constant of saponification reaction in batch reactor
21.	Rate constant of saponification reaction in CSTR
22.	To study RTD in Packed bed reactor.

### Text book:

Elements of Chemical Reaction Engineering by H S Fogler; PHI.

### Reference books:

Chemical Reaction Engineering by Octave Levenspiel

Chemical Engineering RC Vol-III

Chemical Reaction Engineering by Gavhane

### Evaluation scheme (available in B.Tech. Ordinance):

- Credits = 1.5
  - Internal marks = 40
- | <u>Component</u>                          | <u>Weightage</u> |
|---|------------------|
| Viva-Voce/ Test                           | 30%              |
| Laboratory Record/Project Report/Seminar  | 40%              |
| Objective Tests/Multiple Choice Questions | 30%              |
- External marks = 60
  - Total marks = 100

### Attendance record:

Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.

## PROCESS MODELING & SIMULATION , CHE402B

Branch / Semester :B.Tech- Chemical Engineering, 8<sup>th</sup> Semester

Credits : 4

**Objective :** This subject deals with the process modelling and simulation of various process that are widely used in the different chemical industries. Modeling is the process of producing a model. A model is a representation of the construction and working of some system of interest. The purpose of a model is to enable the analyst to predict the effect of changes to the system. A simulation of a system is the operation of a model of the system. The model can be reconfigured and experimented. Simulation is a tool to evaluate the performance of a system, existing or proposed, under different configurations of interest and over long periods of real time.

### Internal Assessment details:

Minor-I-7.5 marks

Minor-II- 7.5 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

**Total Internal marks = 25 marks**

**Final = 75 marks**

**Total = 100 marks**

### Tentative lesson plan:

Lecture No.s	Topics Covered
1-8	UNIT-1 Introduction: Definition and Use of mathematical models, scope of coverage, principles of formulations. Fundamental Laws- continuity equations, energy equations, equations of motion, transport equations, equation of state, equilibrium, chemical kinetics. Lumped and distributed parameter systems. Use of Partial and ordinary differential equations in modeling.
8-22	UNIT-2 Mathematical Models of Chemical Engineering System - Series of isothermal constant hold up CSTRs, Gravity flow tank, CSTRs with variable hold ups, Heated tanks, Gas phase pressurized CSTR, Isothermal and non-isothermal CSTRs systems. Single and Multi-component vaporizers. Reactor with mass transfer, Interacting and non interacting tanks, bioreactor
22-32	UNIT-3 Batch reactor, semi batch reactor, Plug flow reactor, Ideal and non-ideal binary Distillation Column, Batch Distillation with hold up, pH systems, absorption column, liquid liquid extraction, double pipe heat exchanger. Numerical simulation methods, Interval Halving, Newton Raphson Methods etc., Numerical Integration
32-40	UNIT-4 Analysis and design of advanced control - Dead time compensation, Inverse response, Control System with Multiple Loops, Feed forward and Ratio control, Adaptive and Inferential control. Process control using digital computers-Digital Computer Control loops, Continuous and Discrete time systems, Z- Transforms.

**TEXT BOOKS:** 1. Process modelling simulation and control: W.L. Luyben- McGraw Hill.

2. Chemical Process Control - An Introduction to Theory and Practice: G.

Stephanopoulos - Prentice Hall of India, New Delhi.

**REFERENCE BOOKS:** 1. Chemical Process simulation: Asghar Husain- Wiley Eastern.

2. Chemical Engineering Dynamics: E.J. Dunn- V.C.H.

3. Modeling and simulation in chemical Engineering: R.G.E. Franks Wiley Interscience.

### Process Engineering Economics (CHE-404B)

Branch / Semester :B.Tech- Chemical Engineering, 8<sup>th</sup> Semester

Credits : 4

#### Course Objective:

This subject intends to aware the chemical engineering students about the economic calculations related to investment and profit of a company set-up.

#### Lecture Plan:

No of Lectures	Topics
5	UNIT-I: Introduction, Flow-sheeting, Plant Location, Plant Layout, Health and Safety Hazards, Degree of freedom, Environmental Protection.
6	UNIT-II: Cost and Asset Accounting: Basic relationships in accounting, Balance Sheet Cost Estimation: Cash Flow, Capital Investments, Methods for estimating Capital Investments ,Cost Indexes, Total Product Cost
4	Interest and Investment Costs: Types of Interest, Present Worth and Discount, Annuities, Perpetuities and Capitalized Costs
8	UNIT-III: Depreciation and Taxes: Types of Taxes, Types of Depreciation, Methods for Determining Depreciation, Insurance: Types of Insurance & legal responsibility.
9	UNIT-IV: Profitability: Profitability standards, Methods for Profitability Evaluation, Alternative Investments.
8	Optimum design: General Procedure for determining optimum conditions, Break-Even chart and its significance for optimum analysis, optimum conditions in cyclic operations, Examples of optimum design in a chemical process plant.

#### TEXT BOOKS:

1. Plant design and Economics for chemical Engineering: M.S. Peters and K.D. Timmerhaus- Mc Graw Hill.
2. Chemical Engineering Vol. 6: J.M. Coulson and Richardson J.F.-Pergamon Press.

#### REFERENCE BOOKS:

1. Strategy of process engineering: D.F. Rudd and C.C. wat sons- John wiley and sons.
2. Optimization Theory and practice: G.S.G. Beveridge and R.S. Schechter- Mc Graw Hill.
3. Project Engineering of Processes Plants: H.F. Rase and M.H. Barrow - John Willey.

#### Evaluation scheme:

- Credits = 4
- Internal marks = 25

<u>Component</u>	<u>Weightage</u>
Minor test-I	30%
Minor test-II	30%
Assignment / class performance	20%
Surprise quiz / tutorial tests (2+2)	20%

- External marks = 75
- Total marks = 100

## **Environmental Pollution Control, CHE 351B**

**Branch / Semester : B.Tech- Chemical Engineering/8<sup>th</sup> Semester**

**Credits : 4**

**Objective :** This subject deals with the detailed study of different kind of pollution including air, water pollution as well as solid waste management. Detailed study of different methods of sampling of various pollutants, their control methods and different laws to mitigate these problems. Detailed waste water treatment methods helps to study the step by step method carried out in effluent treatment plants.

**Internal Assesment details:**

Minor-I-15 marks

Minor-II- 15 marks

Assignments: 5 marks

Surprise/Quiz Test: 5 marks

**Total Internal marks = 25 marks**

**External = 75 marks**

**Total = 100 marks**

**Tentative lesson plan:**

<b>Lecture No.s</b>	<b>Topics Covered</b>
1-6	Unit 1: Causes of Environmental Pollution: Interaction of systems, Environmental disturbances, public awareness and action, population and economic growth, Industrialization, Energy growth, Man made disturbances, ozone layer depletion, global warming, Acid rain effect.
7-17	Unit 2: Air Pollution : Types of air pollutants, Sources of air pollution, effects of air pollutants, Air sampling, Air pollution control equipments, Lapse rate, different plume patterns, air pollution legislation and regulations
18-28	Unit 3: Water Pollution: types of water pollutants, sources of water pollution, Effects of water pollution, control of water pollution, Wastewater and sludge treatment methods, Sources and characteristics of wastewater, Primary treatment, Secondary treatment, Tertiary treatment, Adsorption, Disinfection, Sources and characteristics of sludge, Sludge treatment and disposal methods, wastewater reclamation and reuse, water pollution legislation and regulations
29-40	Unit 4: Solid waste management and disposal methods, Industrial pollution monitoring and control including treatment methods in various process industries (such as refineries, fertilizer, paper and pulp industries, sugar manufacturing units, textile, dairy waste, mining and metallurgical industries etc.)

**TEXT BOOKS:**

1. "Environmental Engineering", Peavy H.S. and Rowe D.R.-McGraw Hill.
2. "Environment Pollution Control Engineering", revised second edition, C.S.Rao, New Age International Limited Publishers.

**REFERENCE BOOKS:**

1. "Air Pollution", M.N. Rao and H.V.N. Rao- Tata McGraw Hill.
2. "Environmental Engineering", G.N. Panday and G.C. Carney- Tata Mc Graw Hill.
3. "Wastewater treatment disposal and Reuse", Metcalf and Eddy - Tata Mc-Graw Hill.



**Novel Separation Techniques , CHE452B****Branch / Semester : B.Tech- Chemical Engineering/8<sup>th</sup> Semester****Credits : 4**

<b>S. No.</b>	<b>Contents</b>	<b>No. of Lectures</b>
1	Separation processes in Chemical & Biochemical industries	04
2	Categorization of separation processes, equilibrium and rate governed processes.	04
3	Nature of bubbles and foams, stability of foams, foam fraction techniques	04
4	Batch, continuous, single stage and multistage columns.	04
5	Physical factors in membranes, osmotic pressure, partition coefficient and permeability, concentration polarization, electrolyte diffusion facilitated transport.	04
6	Ultrafiltration, reverse osmosis and electrodialysis, membrane structure and production.	04
7	Theory and application of pervaporation, permeation	04
8	Critical extraction and freeze drying.	04
9	Theory of adsorption, application, adsorption isotherms, adsorption hysteresis.	04
10	Batch and continuous adsorption etc.	04
<b>Total Lectures</b>		<b>40</b>

**ENVIRONMENTAL POLLUTION CONTROL LAB, CHE410B**  
**Branch / Semester : B.Tech- Chemical Engineering/8<sup>th</sup> Semester**  
**Credits : 1**

**List of Experiments / Exercises:**

1. Determination of pH and Temperature
2. Determination of dissolved oxygen
3. Determination of BOD
4. Determination of COD
5. Determination of Solids
6. Determination of Conductivity
7. Determination of Turbidity
8. Determination of Acidity and Alkalinity
9. Determination of Hardness
10. Determination of Chlorides, Fluorides and Nitrates
11. Determination of Heavy Metals.
12. Determination of Air pollutants.

**NOTE:**

1. The students will be required to perform the 08 experiments from above list and two experiments may either be performed from the above list or designed and set by the Dept. as per the scope of the syllabus of CHE451B.
2. The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
3. Electronics gadgets including Cellular phones are not allowed in the examination.

## Modeling and Simulation Lab (CHE414B)

Branch / Semester : B.Tech- Chemical Engineering/8<sup>th</sup> Semester

Credits : 1

Lab plan:

Lab	Topics
23.	Isothermal CSTR
24.	Non-Isothermal CSTR
25.	Isothermal Batch Reactor
26.	Non-Isothermal Batch Reactor
27.	Ideal Binary Distillation Column
28.	Flash Calculation
29.	Gravity flow tank
30.	Runga –kutta method/Euler’s method
31.	Isothermal CSTR

### TEXT / REFERENCE BOOKS:

- Process modelling simulation and control: W.L. Luyben- McGraw Hill.
- Chemical Process Control - An Introduction to Theory and Practice: G. Stephanopoulos - Prentice Hall of India, New Delhi.
- Chemical Process simulation: Asghar Husain- Wiley Eastern.
- Chemical Engineering Dynamics: E.J. Dunn- V.C.H.
- Modeling and simulation in chemical Engineering: R.G.E. Franks Wiley Interscience.

### Note:

- Software such as Aspen Plus/Chem-CAD, MATLAB, C++ etc. may be used in modeling above problems. Mathematical modeling of Chemical Engineering problems will be done on computers with the help of related software packages.
- The students will be required to perform the 06 experiments from above list and two experiments may either be performed from the above list or designed and set by the Dept. as per the scope of the syllabus of CHE402B.

### Evaluation scheme (available in M.Tech. Ordinance):

- Credits = 1
- Internal marks = 20

<u>Component</u>	<u>Weightage</u>
Viva-Voce/ Test	30%
Laboratory Record/Project Report/Seminar	40%
Objective Tests/Multiple Choice Questions	30%
- External marks = 30
- Total marks = 50

### Attendance record:

Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.