

# Anna University Coimbatore

## B. Tech Chemical Engineering

### Regulations 2007

V Semester								
S. No	Theory	Hours / Week				Marks		
		L	T	P	C	Sessional	Exam	Total
1	Chemical Engineering Thermodynamics – I	3	0	0	3	50	50	100
2	Chemical Process Industries – I	3	0	0	3	50	50	100
3	Heat Transfer Operations	3	0	0	3	50	50	100
4	Mass Transfer – I	3	1	0	4	50	50	100
5	Chemical Process Plant Safety	3	0	0	3	50	50	100
6	Energy Technology	3	0	0	3	50	50	100
	<b>PRACTICALS</b>							
1	Heat Transfer Laboratory	0	0	3	1.5	50	50	100
2	Technical Analysis Laboratory	0	0	3	1.5	50	50	100
3	Instrumental Analysis Laboratory	0	0	3	1.5	50	50	100

VI Semester								
S. No	THEORY	Hours / Week				Marks		
		L	T	P	C	Sessional	Exam	Total
1	Chemical Engineering Thermodynamics – II	3	0	0	3	50	50	100
2	Chemical Process Industries – II	3	0	0	3	50	50	100
3	Chemical Reaction Engineering – I	3	1	0	4	50	50	100
4	Mass Transfer – II	3	1	0	4	50	50	100
5	Chemical Process Equipment Design & Drawing – I	3	0	3	6	50	50	100
6	Process Instrumentation Dynamic & Control	3	0	0	3	50	50	100
	<b>PRACTICALS</b>							
1	Mass Transfer Laboratory	0	0	3	1.5	50	50	100
2	Process Control Laboratory	0	0	3	1.5	50	50	100
3	Chemical Reaction Engineering Laboratory	0	0	3	1.5	50	50	100

## V SEMESTER

### CHEMICAL ENGINEERING THERMO DYNAMICS I

3 0 0 3

#### AIM

To present thermodynamic principles from a chemical engineering viewpoint.

#### OBJECTIVES

The Students will be well versed with the behaviour of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

#### UNIT I BASIC CONCEPTS 6

The terminologies of thermodynamics, the variables and quantities of thermodynamics, categorization of systems and processes. Energy classifications, point and path properties, energy in transition, heat and work, reversible and irreversible processes, phase rule.

#### UNIT II FIRST LAW OF THERMODYNAMICS 6

The first law and internal energy, statements of first law for the non flow and flow systems, enthalpy and heat capacity limitations of the first law.

#### UNIT III SECOND LAW OF THERMODYNAMICS 6

Statements of the second law of thermodynamics, available and unavailable energies, and the entropy function.

#### UNIT IV THERMODYNAMIC FORMULATIONS 9

Measurable quantities, basic energy relations, maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as function of pressure and temperature, other formulations involving  $C_p$  and  $C_v$ , complex thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

#### UNIT V THERMODYNAMIC PROPERTIES OF REAL GASES 9

The PVT behaviour of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas, problems; compressibility factors, generalised equations of state, property estimation via generalised equation of state; fugacity and fugacity coefficients of real gases.

#### UNIT VI COMPRESSION OF FLUIDS 9

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

**TOTAL: 45**

#### TEXT BOOKS

1. Smith, J.M., and Van Ness, H.C., "Introduction to Chemical Engineering Thermodynamics", Kogakushai 1976.
2. Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt. Ltd. 2001.

#### REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II, Thermodynamics", John Wiley 1970.
2. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
3. Sandler, S.I., "Chemical and Engineering Thermodynamics 2nd edn.", Wiley, 1989.
4. Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn.", Prentice Hall of India Pvt. Ltd., 1990.

## CHEMICAL PROCESS INDUSTRIES I

3 0 0 3

### AIM

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

### OBJECTIVES

To gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

#### UNIT I INTRODUCTION 5

Chemical processing, the role of a chemical engineers in process industries, importance of block diagrams and flow charts, unit operations, unit processes, process utilities and economics, industrial safety and pollution, outline of plant and equipment design, process control and instrumentation.

#### UNIT II MARINE CHEMICALS 4

Sodium chloride, By-products of common salt industry, value added product.

#### UNIT III CHOLORO-ALKALI INDUSTRIES 6

Soda ash and sodium bicarbonate, chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.

#### UNIT IV SULPHUR AND SULPHURIC ACID INDUSTRIES 5

Mining and manufacture of sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.

#### UNIT V PHOSPHORUS INDUSTRIES 5

Posphate rock, beneficiation, phosphoric acid-phosphate.

#### UNIT VI NITROGEN INDUSTRIES 4

Synthesis ammonia and nitric acid.

#### UNIT VII FERTILISER INDUSTRIES 12

Growth elements, functions, nitrogenous fertilizers ammonium sulphate, ammonium nitrate and urea phosphotic fertilizers, single and triple super phosphate, ammonium phosphate, nitro phosphate, potassic fertilizers, potassium chloride, potassium nitrate and phosphate, compound fertilizers and bio-fertilisers.

#### UNIT VIII AGRICHEMICAL INDUSTRIES 4

Insecticides, pesticides, herbicides, plant nutrients and regulators.

**TOTAL : 45**

### **TEXT BOOKS**

1. Austin, G.T., Shreve's Chemical Process Industries, Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984
2. Dryden, C.E., Outlines of Chemicals Technology, Edited and Revised by Gopala Rao, M. and M.Sittig., Second Edition, Affiliated East-West press, 1993.

### **REFERENCES**

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II, Thermodynamics", John Wiley 1970.
2. Kent, J.A., (ed), Riggel's Hand book of Industrial Chemistry, Van Nostrand Reinhold, 1974.
3. CHEMTECH 1-4, Chemical Engineering Education Development Centre, I.I.T., Madras 1975-78.
4. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
5. Sandler, S.I., "Chemical and Engineering Thermodynamics 2nd edn.", Wiley, 1989.
6. Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn.", Prentice Hall of India Pvt. Ltd., 1990.

## HEAT TRANSFER OPERATIONS

3 0 0 3

### AIM

To provide fundamental instruction in various methods of heat transfer through different media.

### OBJECTIVES

To gain knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers, evaporation etc.,

#### UNIT I BASIC PRINCIPLES 4

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference.

#### UNIT II CONDUCTION 8

Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal conductivity measurement; effect of temperature on thermal conductivity; conduction through liquids.

#### UNIT III FILM COEFFICIENTS AND THEIR APPLICATION 8

Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source - Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction.

#### UNIT IV CONVECTION 8

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection - Heat transfer from condensing vapours, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidised beds.

#### UNIT V HEAT EXCHANGERS 8

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors and Wilson's plot - Design of various types of heat exchangers - Design of furnaces - Design of condensers, - Design of tubular reactors.

#### UNIT VI RADIATION 4

Concept of thermal radiations - Black body concept - Stefan Boltzman's law - concept of grey body - radiation between surfaces.

#### UNIT VII EVAPORATION 5

Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

**TOTAL : 45**

### **TEXT BOOKS**

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill Recent Edn.
2. Binay K.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.

### **REFERENCES**

1. Coulson, J.M., Richardson, J.F., "Chemical Engineering", Vol. I., Pergamon and ECBS, 1970.
2. Kern, D.Q., "Process Heat Transfer", McGraw-Hill - Revised edition - 1999.



### **TEXT BOOKS**

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill Edn., 1993.
2. Coulson, J.M., Richardson, J.F., "Chemical Engineering", Vol. I, Pergamon Press, 1977.

### **REFERENCES**

1. Treybal, R.E., "Mass Transfer Operations", McGraw-Hill Kogakusha, 1980.
2. Foust, A.S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", Second Edition, Wiley, 1980.
3. Roman Zarzytci, Andrzej Chacuk, "Absorption: Fundamentals and Application", Pergamon Press, 1993.
4. Skelland, A.H.P., "Diffusional Mass Transfer", Krieger, Malabar FL (1985).  
Strigle (jr), R.F., "Packed Tower Design and Applications", Second Edition, Gulf Publishing Company, USA, 1994.

## CHEMICAL PROCESS PLANT SAFETY

3 0 0 3

### AIM

To get awareness on the important of total plant safety in a Chemical Industry.

### OBJECTIVES

Become a skill and person in hazopard hazarel analysis and able to find out the root cause of an accident. Gain knowledge in devising safety policy and procedures to be adopted to implement total safety in a plant

#### UNIT I INTRODUCTION 4

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; social environmental setup; tolerance limit of the society; psychological attitude towards safety programmes.

#### UNIT II SAFETY PROGRAMMES 4

Elements of safety programme; effective realization; economic and social benefits; effective communication training at various levels of production and operation.

#### UNIT III INDUSTRIAL SAFETY 8

Chemical process industries; potential hazards; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

#### UNIT IV SAFETY PERFORMANCE 7

Appraisal; effective steps to implement safety procedures; periodic inspection and study of plant layout and constant maintenance; periodic advice and checking to follow safety procedures; proper selection and replacement of handling equipments; personal protective equipments.

#### UNIT V ACCIDENTS 6

Industrial accidents – accident costs – identification of accident spots; remedial measures; identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.

#### UNIT VI POLLUTION 6

Atmospheric pollution – chemicals and dust – toxicity toxic materials and gases – environmental pollution by effluent and industrial wastes – treatment.

#### UNIT VII HEALTH HAZARDS AND LEGAL ASPECTS 6

Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act.

#### UNIT VIII PROMOTION OF INDUSTRIAL SAFETY 4

Role of Government, safety organizations, management and trade unions in promoting industrial safety.

**TOTAL : 45**

### **TEXT BOOKS**

1. William Handley, Industrial Safety Hand Book McGraw-Hill Book Company 2<sup>nd</sup> Edition, 1969.
2. Fawatt, H.H. and Wood, W.S. Safety and Accident Prevention in Chemical Operation, Interscience, 1965.

### **REFERENCES**

1. Heinrich, H.W. Dan Peterson, P.E. and Nester Rood. Industrial Accident Prevention, McGraw-Hill Book Co., 1980
2. Blake, R.P., Industrial Safety, Prentice Hall Inc., New Jersey – 3<sup>rd</sup> Edn. 1963

## ENERGY TECHNOLOGY

3 0 0 3

### UNIT I CONVENTIONAL ENERGY SOURCES 9

Energy sources, coal, oil, natural gas, nuclear fuels, Nature, formation, resources, energy situation, Exploration.

### UNIT II NEW AND RENEWABLE ENERGY SOURCES 9

Study of power plants using new and renewable energy sources. Viz., wind, Geothermal, ocean thermal, tidal wave, bio gas plant, biomass energy, alternate fuels from biomass for automotive engines.

### UNIT III DIRECT ENERGY CONSERVATION. 9

Direct energy conservation, solar cells, photovoltaic cells, theory of junction type cells and construction details, fuel cells, types, practical of considerations. Magneto hydro dynamic generator, electrical conductivity of gas and formulation of MHD, performance, prospects of large, medium and scale power generation.

### UNIT IV NEW ENERGY CONVERSION SYSTEMS. 9

Other energy transformations, coal gasification and liquefaction, role of coal in the energy crisis, fluidized bed combustion. Synfuels, Hydrogen, method of application, cogeneration.

### UNIT V ENERGY CONSERVATION AND MANAGEMENT. 9

Waste Heat recovery. heat pump.  
Demand forecasting Global developments, Principles of energy accounting and auditing. Economic. Principles of energy management. Technology assessment.

**TOTAL: 45**

### TEXT BOOKS.

- 1). Conventional Energy technology: Fuel and Chemical Engineering by S.B.Pandya Tata McGraw Hill New Delhi (1998)
- 2). Solar Energy Utilisation by G.D.Rai, Khanna Publishers New Delhi.

### REFERENCE BOOKS.

1. S.S.Penner and ICE Man, Energy, Addition Wesley Publishing Co, New York, USA, 1974.
2. P.E. Albert Thimann, Handbook of energy Audit, The Fairmount press Inc., Georgia, USA, 1979.
3. S. David Hu, Handbook of industrial Energy conservation, Van Nostrand, New York, USA, 1983
4. H. Christopher & H. Armsteed, Geothermal Energy, John Wiley, New York, USA, 1978.
5. D.L. Pulfrey, Photovoltaic Power Generation, Van Nostrand, Usa., 1983.
6. E. Richard et al., Energy Economics, Cambridge University Press, Uk, 1981.

## HEAT TRANSFER LABORATORY

3 0 0 1.5

**AIM** : To determine experimentally the heat transfer coefficient of different fluid in different equipments.

**OBJECTIVES** : To have a wide knowledge on the conductive, convective and radiative type of heat transfer under different operative conditions and also the selection of instruments to measure the heat.

### LIST OF EXPERIMENTS

1. Laminar Flow
2. Condenser (Vertical)
3. Condenser (Horizontal)
4. Convective Heat Transfer
5. Transient Heat Conduction
6. Agitated vessel
7. Natural Convection
8. Jacketed Kettle
9. Calculation of Graetz Number
10. Open Pan Evaporator
11. Temperature Control Loop
12. Characteristics of Temperature Measuring Device
13. Forced Convection

**\* Minimum 10 experiments shall be offered**

TOTAL = 45

### LIST OF EQUIPMENT

1. Data Logger
2. Heat Exchanger
3. Condenser
4. Stirrers
5. Jacketed Kettle
6. Pan Evaporator
7. Mini Boiler
8. Controllers for Temperature
9. Temperature Measuring Devices

## TECHNICAL ANALYSIS LAB

3 0 0 1.5

**AIM:** To determine experimentally the various properties of the oils, soaps, fats, chemicals etc.,

**OBJECTIVES:** To have a thorough understanding on the behaviors and characteristics of sub materials at different operating conditions

### LIST OF EXPERIMENTS

1. Oil Analysis: (3 experiments)
  - a) Acid value
  - b) Saponification value
  - c) Iodine value
2. Soap Analysis: (2 experiments)
  - a) Alkali Content
  - b) Fatty acid content of Soap
3. Estimation of purity of glycerol: by Dichromatic method
4. Analysis of water:  
Determination chlorine demand in water: Estimation of residual chlorine in water by volumetric method
5. Cement Analysis (3 experiments)
  - a) Estimation of silica content
  - b) Estimation of calcium oxide content
  - c) Estimation of mixed oxide content
6. Fertilizer Analysis:  
Estimation of Nitrogen in Urea by Kjeldals method

\* **Minimum 10 experiments shall be offered**

**TOTAL: 45**

## INSTRUMENTAL ANALYSIS LABORATORY

0 0 3 1.5

- 1) Analysis of Composition of Gas & Liquids - Gas Chromatography
- 2) Spectrophotometer
- 3) Polarograph
- 4) Flame photo meter
- 5) PH meter
- 6) Polarimeter
- 7) Conductometric & Potentiometric titrations
- 8) Testing of Petroleum products
- 9) Time constant of thermometer & monometer
- 10) Dissolve oxygen meter
- 11) Differential Thermal Analysis (DTA)



**AIM**

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

**OBJECTIVES**

To gain Knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

**UNIT I PULP AND PAPER INDUSTRIES 5**

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards

**UNIT II SUGAR AND STARCH INDUSTRIES 4**

Raw and refined sugar, by products of sugar industries, Starch and starch derivatives.

**UNIT III OILS, FATS, SOAPS AND DETERGENT INDUSTRIES 9**

Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

**UNIT IV PETROLEUM AND PETROCHEMICAL INDUSTRIES 9**

Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methane, olefines, acetylenes and aromatics and products obtained from them by various unit processes.

**UNIT V RUBBER AND POLYMERS 9**

Monomers – Thermosetting and Thermoplastic materials – General properties and Applications of Resins – Polymerisation processes – different types - Natural rubber; Synthetic rubber such as SBR, NBR, CR - Fundamental methods of processing of synthetic Rubbers.

**UNIT VI SYNTHETIC FIBRE AND FILM INDUSTRIES 9**

Natural and synthetic fibres – properties of - Poly amides – manufacture of Nylon 6. 6. Polyesters Fibres – manufacturer of – Cellulosic Fibres – Viscose Rayon production manufacture of films - cellulose Acetate, PVC, Polyesters - polyethylene

**TOTAL : 45****TEXT BOOKS**

1. Austin, G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.
2. Dryden, C.E., "Outlines of Chemical Technology", Edited and Revised by Gopala Rao. M. and M.Sittig, Second edition, Affiliated East-West press, 1993.

**REFERENCE**

1. Kent, J.A.(ed), "Riggel's Hand Book of Industrial Chemistry", Van Nostrand Reinhold, 1974.
2. CHEMTECH 1-4, "Chemical Engineering Education Development Centre", I.I.T., Madras 1975-78.





### **TEXT BOOKS**

1. R.E.Treybal, "Mass Transfer Operations", McGraw-Hill, Kogakusha, 1980.
2. W.L McCabe J.C.Smith, and Harriot. P., "Unit Operations of Chemical Engineering", sixth edition McGraw-Hill, International Edition, 2001.

### **REFERENCES**

1. C.Judson King "Separation Processes", Tata McGraw-Hill 1974.
2. A.H.P.Skelland, "Diffusional Mass Transfer", Krieger, Malapur, FL (1985).
3. Roman Zarfyki and Andrzej Chacuk, "Absorption Fundamentals and Applications", Pergamon Press, 1993.
4. P.Wankat "Equilibrium Stage Separations", Prentice Hall, 1993.
5. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn. Gulf Publishing Company U.S.A. 1994.

**CHEMICAL PROCESS EQUIPMENT DESIGN &  
DRAWING I**

3 0 3 100 6

Pressure vessels (jacketed and autoclave)  
Filters  
Batch dryers  
Rotary dryers  
Crystallizers  
Cooling Towers  
Storage tank  
Cyclone separator

**TEXT BOOKS**

1. M.V.Joshi-Equipment design
2. brown & young- Equipment design
3. Coulson & Richardson-Chemical Engineering Volume-VI
4. IS codes-2825,4503,803,1515.

# PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL

3 0 0 100 3

## AIM

To introduce control equipments used to control the production process of a chemical factory and to introduce the control mechanism thro' automation and computers.

## OBJECTIVES

Gains knowledge in designing a control system and identifying the alternative control configuration for a given process plant or entire plant. He will be familiar with the control mechanism before attempting to tackle process control problems.

## UNIT I

9

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

## UNIT II

9

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

## UNIT III

9

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

## UNIT IV

9

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

## UNIT V

9

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency,  $p^H$ , concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

**TOTAL : 45**

## TEXT BOOKS

1. Coughnowr and Koppel, "Process Systems Analysis and Control", McGraw-Hill, New York, 1986.
2. George Stephanopolous, "Chemical Process Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 1990.
3. Patranabis.D, Principles of Process control, II edition, Tata McGraw-Hill Publishing Co. Ltd., 1981.
4. Peter Harriott, Processcontrol, Tata McGraw-Hill Publishing Co., Reprint 2004.

## REFERENCES

1. Thomas, E.Marlin, Process Control, 2<sup>nd</sup> Edn, McGraw-Hills International Edn. 2000.
2. George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.
3. Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons, Japan.
4. Emenule, S.Savas, "Computer Control of Industrial Processes", McGraw-Hill, London, 1965.
5. Eckman, D.P., "Industrial Instrumentation", Wiley, 1978.

## MASS TRANSFER LAB

0 0 3 100 1.5

**AIM :** To determine experimentally certain physical properties of fluids and solids

**OBJECTIVES :** To gain knowledge on the determination of important data for the design and operation of the process equipments.

### LIST OF EXPERIMENTS

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. Rotary dryer
10. Surface Evaporation

**\* Minimum 10 experiments shall be offered.**

**TOTAL: 45**

## PROCESS CONTROL LAB

0 0 3 100 1.5

**AIM:** To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

**OBJECTIVES:** To gain knowledge on the development and use of right type of control dynamics for process control under different operative conditions.

### LIST OF EXPERIMENTS

1. ON-OFF control of thermal process
2. Flow control loop and Flow Transmitter
3. Level Control loop and Level Transmitter
4. Pressure control loop and Pressure Transmitter
5. Control valve characteristics
6. Verifying the inherent characteristics of control valve
7. Flow co-efficient of control valve
8. Range ability of control valve
9. Verifying the response of Non-Interacting level System
10. Verifying the response of Interacting level System
11. Effect of PI controller on flow control System
12. The effect of a P controller on level process for set point and load changes
13. Effect of P, PI, PID Controller on Pressure Control Loop
14. Optimum controller setting using Zigler's Nichols Methods
15. Optimum Controller Tuning on Level Process Station

**\*Minimum 10 experiments shall be offered.**

**TOTAL: 45**

**AIM:** To determine experimentally the kinetics and rate constants of reactions in different types of reactors.

**OBJECTIVES:** To gain knowledge in the design of reactors.

**LIST OF EXPERIMENTS\***

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series

**\*Minimum experiments shall be offered.**

**TOTAL = 45**