

**COURSE STRUCTURES & SYLLABUS**  
(3<sup>rd</sup> Semester)

**FOR DIPLOMA IN**  
**CHEMICAL ENGINEERING**

**YEAR – 2014**

**As per A.I.C.T.E approval**  
**Under guidance from**  
**Directorate of Technical Education & Training (Orissa)**

*Prepared by*

**State Council for Technical Education**  
**& Vocational Training, Orissa.**  
**Unit – VIII, Bhubaneswar**

## **1. SALIENT FEATURES OF THE DIPLOMA PROGRAMME IN CHEMICAL ENGINEERING**

1. Name of the Programme : Diploma Programme in Chemical Engineering
2. Duration of the Programme : Three Years
3. Entry Qualifications : Matriculation or equivalent as prescribed by AICTE
4. Admission Criteria : Entrance Examination/Test (DET)
5. Intake : 40
6. Pattern of the Programme : Semester Pattern
7. Ratio between Theory & Practical : 50 : 50

## 2. JOB OPPORTUNITIES

Employment opportunities for diploma holder in Chemical Engineering are visualized in following industries at various levels/positions:

- (i) *Chemical and Allied Industries like*
  - (a) Fertilizer industry
  - (b) Petroleum refinery and petrochemical industry
  - (c) Oil and natural gas corporation
  - (d) Steel plant
  - (e) Cement plant
  - (f) Cosmetic industry
  - (g) Sugar industry
  - (h) Mineral industry
  - (i) Pulp and Paper industry
  - (j) Food Processing industry
  - (k) Consumer goods industry etc.
  - (l) Polymer industry
  - (m) Food industry
  - (n) Agro industry
  - (o) Leather industry
  - (p) Pharmaceutical industry
  - (q) Distilleries
  - (r) Paint and dye industry
  - (s) Rubber industry
  - (t) Soap & detergent industry
  - (u) Textile industry etc.

In various functional areas like erection and commissioning of plant, plant operation, production, maintenance and safety, quality control, inspection and testing, marketing and sales, consultancy services and areas concerning environmental protection.

- (i) *Research Organizations like CSIR laboratories, Defense laboratories, Atomic energy establishments etc.*
- (ii) *Entrepreneurs to small/tiny units especially food, agro and chemical industries.*

### 3. COURSE OBJECTIVES

Keeping in view the employment opportunities of diploma holders in Chemical Engineering, the course is aimed at developing following knowledge and skills in the students:

1. Basic understanding of concepts and principles related to applied sciences as a foundation for further studies.
2. Development of communication and interpersonal skills for effective functioning in the world of work.
3. Understanding of basic concepts and principles of mechanical, electrical and civil engineering so as to enable the students to apply the knowledge of these principles to the field of chemical engineering.
4. Ability to read and interpret drawings related to plant layout, process equipment and components.
5. Knowledge of various materials used in chemical processes, their properties and specifications.
6. Knowledge and associated skills of various unit operations, unit processes and process instrumentation in process industry.
7. Ability to calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.
8. Ability to control the process and quality of the products commensurating with laid specifications.
9. Understanding of basic principles of managing men, material and machines/ equipment for optimum production.
10. Appreciation of the need of clean environment and its deterioration by various emissions from industry and preventive procedures and knowledge of safety regulations in process industry.
11. Development of generic skills of thinking and problem-solving, communication, attitudes and value system for effective functioning in a process industry.
12. Proficiency in the use of computers.
13. Basic manual and machining skills as an aid to function effectively in the process industry.
14. Knowledge of testing and quality control activities.
15. Detailed knowledge of petroleum and petroleum products along with processes involved in their production.
16. Detailed knowledge of fertilizers and technology involved in their production along with important fertilizer plants in India.
17. Development of good personality in order to have effective communication and business ethics.

#### 4. DERIVING CURRICULUM AREAS FROM COURSE OBJECTIVES

The following curriculum areas have been derived from course objectives.

Sr. No.	Curriculum Objectives	Curriculum Areas/Subjects
1.	Basic understanding of concepts and principles related to applied sciences as a foundation for further studies.	<ul style="list-style-type: none"> <li>- Applied Physics</li> <li>- Applied Chemistry</li> <li>- Applied Mathematics</li> </ul>
2.	Development of communication and interpersonal skills for effective functioning in the world of work.	<ul style="list-style-type: none"> <li>- Communication Skills</li> </ul>
3.	Understanding of basic concepts and principles of mechanical, electrical and civil engineering so as to enable the students to apply the knowledge of these principles to the field of chemical engineering.	<ul style="list-style-type: none"> <li>- General Engineering</li> </ul>
4.	Ability to read and interpret drawings related to plant layout, process equipment and components.	<ul style="list-style-type: none"> <li>- Engineering Drawing</li> <li>- Process Equipment Design &amp; Drawing</li> </ul>
5.	Knowledge of various materials used in chemical processes, their properties and specifications.	<ul style="list-style-type: none"> <li>- Chemical Process Industries</li> <li>- Engineering Materials</li> <li>- Applied Chemistry</li> </ul>
6.	Knowledge and associated skills of various unit operations, unit processes and process instrumentation in process industry.	<ul style="list-style-type: none"> <li>- Introduction to Chemical Engineering</li> <li>- Fluid Flow</li> <li>- Heat Transfer</li> <li>- Mechanical Operations</li> <li>- Mass Transfer</li> <li>- Process Instrumentation</li> <li>- Engineering Thermodynamics</li> <li>- Process Utilities</li> <li>- Reaction Engineering</li> </ul>
7.	Ability to calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.	<ul style="list-style-type: none"> <li>- Industrial Chemical Calculations</li> <li>- Introduction to Chemical Engineering</li> </ul>
8.	Ability to control the process and quality of the products commiserating with laid specifications.	<ul style="list-style-type: none"> <li>- Elective/Specializations</li> <li>- Chemical Process Industries</li> <li>- Process Instrumentation</li> <li>- Engineering, Materials</li> <li>- Engineering Thermodynamics</li> <li>- Reaction Engineering</li> </ul>

9.	Understanding of basic principles of managing men, material and machines/ equipment for optimum production.	- Entrepreneurship Development and Management
10.	Appreciation of the need of clean environment and its deterioration by various emissions from industry and preventive procedures and knowledge of safety regulations in process industry.	- Environmental Engineering and Safety
11.	Development of generic skills of thinking and problem-solving, communication, attitudes and value system for effective functioning in a process industry.	- Industrial Visits - Project Work - Process Equipment Design and Drawing
12.	Proficiency in the use of computers.	- Computer Applications in Chemical Engineering - Basics of Information Technology
13.	Basic manual and machining skills as an aid to function effectively in the process industry.	- General Workshop Practice
14.	Knowledge of testing and quality control activities.	- Chemical Process Industries
15.	Detailed knowledge of petroleum and petroleum products along with processes involved in their production.	- Petrochemicals
16.	Detailed knowledge of fertilizers and technology involved in their production along with important fertilizer plants in India.	- Fertilizer Technology
17.	Development of good personality in order to have effective communication and business ethics.	- Student Centered activity

## 5. ABSTRACT OF CURRICULUM AREAS/SUBJECTS

### (a) Basic Sciences and Humanities

1. Communication Skills
2. Basics of Information Technology
3. Entrepreneurship Development and Management

### (b) Applied Sciences

4. Applied Mathematics
5. Applied Physics
6. Applied Chemistry

### (c) Basic Courses in Engineering/Technology

7. Engineering Drawing
8. General Workshop Practice
9. General Engineering

**(d) Applied Courses in Engineering/Technology**

10. Introduction to Chemical Engineering
11. Engineering Materials
10. Fluid Flow
11. Mechanical Operations
12. Engineering Thermodynamics
13. Reaction Engineering
14. Industrial Chemical Calculations
15. Heat Transfer
16. Mass Transfer
17. Environmental Engineering and Safety Management
18. Process Instrumentation
19. Chemical Process Industries
20. Process Equipment Design and Drawing
21. Computer Applications in Chemical Engineering
22. Petrochemicals
23. Fertilizer Technology
24. Process utilities
25. Major Project

**(e) Specialised Courses in Engineering/Technology**  
**(Electives-I, any one of the following)**

26. Petrochemical Industries
27. Biotechnology and Bioprocess Engineering
28. Engineering Mathematics-3

# Detailed Curriculum Structure for Diploma in Chemical Engineering

## TEACHING AND EVALUATION SCHEME

### Semester : III

Sl. No.	Subject with Curriculum Reference No	Teaching Scheme (Hours/Week)			Evaluation Scheme						Total Marks
		L	T	P	Theory			Practical			
					End Exam.	Internal Assessment	Class Test	Assignment	End Exam	Sessional	
1.	Industrial Chemistry - 1	3	1	-	70	20	10	-	-	100	
2.	Fluid Mechanics	3	1	-	70	20	10	-	-	100	
3.	Mechanical Operation	4	0	-	70	20	10	-	-	100	
4.	Chemical Process Industries- 1	4	0	-	70	20	10	-	-	100	
5.	Industrial Stoichiometry	3	1	-	70	20	10	-	-	100	
Practical											
1	Industrial Chemistry-1 Laboratory	0	0	3	-	-	-	25	25	50	
2	Fluid Mechanics Laboratory	0	0	3	-	-	-	25	25	50	
3	Mechanical Operation Laboratory	0	0	3	-	-	-	-	25	25	
4	Chemical Engineering Drawing	0	0	3	-	-	-	25	25	50	
5	Computer Laboratory- II	0	0	3	-	-	-	-	25	25	
6	Soft Skill Laboratory-1	0	0	2	-	-	-	-	25	25	
7	Technical Seminar	0	0	2	-	-	-	-	25	25	
	<b>Total</b>	<b>17</b>	<b>3</b>	<b>19</b>	<b>350</b>	<b>100</b>	<b>50</b>	<b>75</b>	<b>175</b>	<b>750</b>	



## INDUSTRIAL CHEMISTRY – I

<i>L</i> 3	<i>T</i> 1	<i>P</i> 0		Curri. Ref. No. : CH-301
Total Contact hours. : 60 <i>Theory : 60 hours</i>			Total Marks : 100	<i>Theory Exam. : 3 hours.</i> <i>End Exam. : 70 Marks</i> I.A. : 20 Marks Assignment:5marks

### RATIONALE :

The phenomenal progress of technology in the 20<sup>th</sup> century has brought dramatic changes in human lifestyles. The technology, which has thus enhanced the quality of human life, is evolved based on scientific research, primarily physical, inorganic and organic chemistry. Use of various organic and inorganic compounds and their physical phenomenon are very much essential for chemical industry. Therefore, knowledge of chemistry is necessary for the success of chemical engineers.

**OBJECTIVE:** On completion of study of Chemistry – I the student will be able to

1. Explain laws of chemical combination
2. Conceptualize acid, base, salt
3. Understand concept of liquids
4. Understand concept of Redox reaction and ionic equilibrium.
5. Understand application of electrochemical reaction
6. Explain role of Colloids

Sl. No.	Topics	Periods	Marks
1	Laws of chemical combination	08	10
2.	Hybridization	07	08
3.	Solutions	10	12
4.	Electro Chemistry	07	10
5.	Colloids	08	10
6.	Ionic equilibrium	10	10
7.	Radioactivity	10	10
<b>Total</b>		60	70

## **COURSE CONTENT**

### **1.0 LAWS OF CHEMICAL COMBINATION**

- 1.1 Law of conservation of mass
- 1.2 Law of definite proportion
- 1.3 Law of multiple proportion
- 1.4 Law of reciprocal proportion
- 1.5 Solve simple problems related to 1.1 to 1.5

### **2.0 HYBRIDISATION**

- 2.1 Hybridization (upto  $sp^3$ )
- 2.2 Concept of sigma and pi bond
- 2.3 VSEPR theory (valence shell electron pair repulsion)
- 2.4 Structures of  $CH_4$ ,  $C_2H_2$ ,  $C_2H_4$  with respect to hybridization
- 2.5 Hydrogen bonding

### **3.0 SOLUTION**

- 3.1 Solution, methods of expression of composition of solution
- 3.2 Dalton's law of partial pressure
- 3.3 Raoult's Law, Henry's law, ideal solution & non ideal solution
- 3.4 Solubility of partially miscible liquids and examples of different liquid-liquid systems
- 3.5 Lowering of vapour pressure, elevation of boiling point, depression in freezing point and calculate molecular mass of non volatile solute
- 3.6 Theory of fractional Distillation
- 3.7 Solubility, concept of saturated, supersaturated solution
- 3.8 Determination of solubility and solubility curve
- 3.9 Osmosis and osmotic pressure and determination of osmotic pressure
- 3.10 Laws of osmotic pressure, Theories of osmosis and concept of reverse osmosis

### **4.0 ELECTROCHEMISTRY**

- 4.1 Concept of Electrolysis & application of electrolysis.
- 4.2 Faraday's laws of electrolysis and numerical problems.
- 4.3 Variation of conductance with temperature, strong & weak electrolyte, cell constant
- 4.4 Concept of redox reaction & cell terminology
- 4.5 Electrochemical cells
- 4.6 Nernst equation
- 4.7 pH of solution and potentiometric titration.

## 5.0 COLLOIDS

- 5.1 classification of different types of colloids
- 5.2 Preparation of colloids
- 5.3 Properties of colloids & Purification of colloids and its applications
- 5.4 Concept of gel, stability of gel
- 5.5 Idea about emulsions.

## 6.0 IONIC EQUILIBRIUM

- 6.1 Ostwald Dilution Law
- 6.2 Theory of strong electrolytes
- 6.3 Degree of dissociation, factors influencing degree of dissociation
- 6.4 Common ion effect & pH of solution & numerical
- 6.5 Solubility equilibria and solubility product
- 6.6 Acid base indicator, choice of indicator, theory of indicators
- 6.7 Buffer solutions

## 7.0 RADIO ACTIVITY

- 7.1 Concept of radioactivity
- 7.2 Compare between alpha, beta and gamma radiation
- 7.3 Detection and measurement of radioactivity
- 7.3 Natural and artificial radioactivity
- 7.4 Group Displacement Law
- 7.5 Half life period of different radioactive element.
- 7.6 Radioactive dating

### Reference Books:

- 1. Physical Chemistry – K. K. Sharma & L. K. Sharma
- 2. Principles of Physical Chemistry – Puri, Sharma & Pathania
- 3. Modern Inorganic Chemistry – Satya Prakash
- 4. Physical chemistry – Bahl & Bhal

## FLUID MECHANICS

<i>L</i> 3	<i>T</i> 1	<i>P</i> 0		Curri. Ref. No. : CH-302
Total Contact hours. : 60 <i>Theory : 60 hours</i>			Total Marks : 100	<i>Theory Exam. : 3 hours.</i> <i>End Exam. : 70 Marks</i> I.A. : 20 Marks Assignment:5marks

### Rationale :

Besides the use of solids, use/application and handling of fluids (e.g. both liquids and gases) is in wide spectrum of engineering practice. Fluid statics, fluid flow phenomena, flow measurement, fluid flow through pipe lines, fluidized bed etc. in an industry is essentially important. There are many units processes particularly in chemical, petrochemical, pharmaceutical, hydro-metallurgical etc. plants in which fluid flow phenomena are of fundamental importance in design consideration. It is therefore, necessary for an engineer planning career in chemical, petrochemical etc. industries to study fluid flow phenomena, selection of the characteristics of different fluid transportation and flow control devices.

**Objectives :** On completion of studies of fluid mechanics the student will be able to

- (i) Understand and explain between fluid statics and fluid dynamics
- (ii) Solve simple problems on flow measurement, Bernoulli's equation etc.
- (iii) Acquaint themselves with various kinds of pumps, blowers & fans
- (iv) Understand various fluid properties like density, viscosity and critical velocity, Reynolds number
- (v) Acquire problem solving skill and improvisation of the process.

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Fluid statics	12	15
2.	Fluid flow phenomenon	16	20
3.	Flow measurements	12	10
4.	Transportation of fluid	12	15
5.	Fluidization	08	10
	<b>Total</b>	<b>60</b>	<b>70</b>

## **CHAPTER – I FLUID STATICS**

- 1.1 Fluid and its classification
- 1.2 Properties of fluid and its units
- 1.3 Newton's law of viscosity, Newtonian & Non-Newtonian fluid, BOUNDARY LAYER
- 1.4 Static pressure and pressure head
- 1.5 Fluid pressure measuring devices
- 1.6 Different types of manometers and its applications
- 1.7 Derivation of manometric equation
- 1.8 Equation of continuity

## **CHAPTER – II FLUID FLOW PHENOMENA**

- 2.1 Types of flow: laminar and turbulent flow, Reynolds's number, critical velocity
- 2.2 Mechanism of fluid flow in pipes, Reynolds' experiment
- 2.3 Bernoulli's theorem, pump work (solve simple problems)
- 2.4 Flow of incompressible fluids in pipe
- 2.5 Friction factor, roughness and estimate friction loss in pipes & coils, equivalent length
- 2.6 Fanning's equation (Solve simple problems),
- 2.7 Friction losses through sudden enlargement and contraction in pipes
- 2.8 Flow of fluids in non circular conduits.
- 2.9 Water hammer.

## **CHAPTER – III FLOW MEASUREMENT**

- 3.1 Working of flow measuring devices, advantages & disadvantages
- 3.2 Expression for flow measurement through orifice meter, venturi meter & Pitot tube
- 3.2 Working of Rota meter and its calibration
- 3.3 Simple problems on flow measurement

## **CHAPTER – IV PUMPS AND FITTINGS**

- 4.1 Concept of transportation of fluid by pipes and tubes
- 4.2 Different pipe fittings and its application
- 4.3 Joints, cocks, reducers and controlling valves
- 4.4 Classification of pumps
- 4.5 Construction and working of reciprocating and centrifugal pumps
- 4.6 Performance characteristics of reciprocating and centrifugal pumps.
- 4.7 Cavitation, Net positive suction head, Air binding & priming of pump
- 4.8 Centrifugal pump troubles and remedies
- 4.9 Working of Piston pump, plunger pump, gear pump, diaphragm pump
- 4.10 Pumping device for gas: blower, compressor and vacuum devices

## **CHAPTER – V FLUIDIZATION**

- 5.1 Pressure drop in porous medium
- 5.2 Drag and drag coefficient
- 5.2 Concept of fluidization and types of fluidization
- 5.3 Minimum fluidization velocity
- 5.4 Fluidized bed pressure drop
- 5.5 Principle of pneumatic conveyance
- 5.6 Flow through packed bed.

### **Reference Books :**

1. Unit Operation of Chemical Engineering, W.L.MC.CABE & J.M.SMITH
2. Introduction to Chemical Engineering by Brown
3. Introduction to Chemical Engineering by Badgero and Banchemo.

## MECHANICAL OPERATION

<i>L</i> 4	<i>T</i> 0	<i>P</i> 4	Curri. Ref. No. : CH-303
Total Contact hrs. : 60 <i>Theory : 60</i>		Total Marks : 100	<i>Theory Exam. : 3 hours.</i> <i>End Exam. : 70 Marks</i> <i>I.A. : 20 Marks</i> <i>Assignment:5marks</i>

### Rational:

Operations related to size reduction, size separation, filtration, mixing, transportation and storage are important in many chemical and hydro-metallurgical industrial practices from the point of view of consequence and process economy. It is therefore, important to study the principles governing the operations named above (known collectively as mechanical operations) the construction & operation of different equipment and selection of equipment for specific purpose from host of different alternatives.

### Objective:

On completion of study of Mechanical operation, the student will be able to operate the various equipment used for different operations like size reduction, size separation, filtration, mixing, transportation and storage and solve simple problems.

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Size reduction	20	20
2.	Size separation	16	20
3.	Filtration	08	10
4.	Mixing	08	10
5.	Transportation & storage	08	10
	<b>Total</b>	60	70

## **COURSE CONTENT**

### **1.0 SIZE REDUCTION**

- 1.1 Objectives of size reduction
- 1.2 State laws of crushing like Bonds law, Rittinger's law, Kick's law
- 1.3 Work index and solve simple problems based on these laws
- 1.3 Classification of size reduction equipment and their construction and operation
- 1.4 Closed and open circuit grinding, dry and wet grinding, free and choke feeding

### **2.0 SIZE SEPARATION**

- 2.1 Objectives of size separation
- 2.2 Shape and size of irregular particle.
- 2.3 Different types of screen analysis, ideal screen & actual screen, material balance
- 2.4 Construction and operation of different types of industrial screens and their effectiveness
- 2.5 Construction and operation of air filters, air separator, cyclone separator, magnetic and Electromagnetic separation
- 2.6 Theory of settling like free and hindered settling, Stoke's law, Classification.
- 2.7 Sedimentation, thickeners, clarifiers, hydraulic classifiers, jigs, classifier riffled table and their use
- 2.8 Principle & operation of froth floatation and its use.

### **3.0 FILTRATION**

- 3.1 Types of filtrations, Theory of filtration, types of cakes, cake resistance, pressure drop, filter medium, filter Aids and related derivation
- 3.2 Classification, constructions and working principles of filtration equipments
- 3.3 Batch and continuous centrifuges with their construction, operation and uses.

### **4.0 MIXING**

- 4.1 Objectives of mixing
- 4.2 Various mixing operations like
  - (i) Mixing of liquid with liquid
  - (ii) Mixing of liquid with solid
  - (iii) Mixing of viscous materials
- 4.3 The flow pattern in agitated vessel
- 4.4 Methods of prevention of swirling and vortex formation.
- 4.5 Different impellers, propellers, paddles used in mixing operation and characteristics

## **5.0 TRANSPORTATION AND STORAGE OF SOLIDS**

- 5.1 Objectives of transportation and storage
- 5.2 Transportation of solid by belt conveyor, apron conveyor, screw Conveyor, bucket elevators, scrapers and pneumatic conveyers
- 5.3 Storage and handling of solids; construction and uses of silos and bins.

### **Reference Books:**

- 1. Unit Operation of Chemical Engineering, W.L.MC.CABE & J.M.SMITH
- 2. Introduction to chemical engineering, BADGER & BANCHERO
- 3. Chemical Engineering Vol-I, COULSON & RICHARDSON



## CHEMICAL PROCESS INDUSTRIES – I

<i>L</i> 4	<i>T</i> 0	<i>P</i> 0		Curri. Ref. No. : CH-304
Total Contact hours : 60 <i>Theory : 60</i>			Total Marks: 100	<i>Theory Exam. : 3 hours.</i> <i>End Exam. : 70 Marks</i> I.A. : 20 Marks Assignment:5marks

### Rationale :

A chemical engineer will primarily work in plants which manufacture various chemical products. Therefore, knowledge of the chemical processes, information about raw material requirement, chemistry of finished product are essential for a student to deal with the manufacturing process and process development in his professional career.

### Objective:

On completion of study of chemical process industries the student should be able to:

1. Explain the raw material, chemistry involved, outlines of manufacturing process and major engineering problems of some important inorganic industrial chemical product.
2. Identify the Indian chemical industries, manufacturing the various chemical products.

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Concept of unit operation & unit process	05	05
2.	Industrial gases	10	10
3.	Acids	05	10
4.	Chloro-alkali industry	05	05
5.	Pulp & paper industry	06	10
6.	Cement, ceramics & glass industry	09	10
7.	Metallurgical Industries	10	10
8.	Fertilizers	10	10
	Total	60	70

## **COURSE CONTENTS:**

### **CHAPTER – I Concept of Unit operation and process**

- 1.1 Concept of unit operation & unit operation
- 1.2 Choice of process technology
- 1.3 Batch and continuous process

### **CHAPTER – II INDUSTRIAL GASES**

- 2.1 Manufacturing process of Hydrogen from propane with a flow sheet
- 2.2 Manufacturing of Oxygen & Nitrogen by Linde Frankl process
- 2.3 Manufacturing of Ammonia commercially
- 2.4 Manufacturing of carbon dioxide
- 2.5 Manufacturing of Acetylene

### **CHAPTER – III ACIDS**

- 3.1 Manufacture of sulfuric acid by contact (DCDA) process
- 3.2 Manufacture of Nitric acid by Ammonia Oxidation or Ostwald's process.
- 3.3 Manufacture of Phosphoric Acid

### **CHAPTER – IV CHLORO-ALKALI INDUSTRY**

- 4.1 Manufacture of soda ash by Solvay's process
- 4.2 Manufacture of caustic soda by electrolysis of brine
- 4.3 Different types of electrolytic cells with their advantages & disadvantages

### **CHAPTER – V PULP & PAPER INDUSTRY**

- 5.1 Manufacture of pulp by sulphate & sulphite process
- 5.2 Recovery of chemicals from black liquor.
- 5.3 Different type of paper products.
- 5.4 Manufacture of paper by wet process.
- 5.5 Additives used in paper production and their application.

## **CHAPTER – VI CEMENT, CERAMIC & GLASS INDUSTRIES**

- 6.1 Different types of cement
- 6.2 Constituents of cement and their characteristics, lime stone beneficiation
- 6.3 Manufacture of portland cement by wet & dry process
- 6.4 Additives used in cement industries
- 6.5 Factors affecting cement industry
- 6.6 Importance of mini cement plant
- 6.7 Ceramics and classify types of ceramic ware
- 6.8 Raw material used in ceramic manufactures
- 6.9 China clay beneficiation
- 6.10 Manufacture of porcelain
- 6.11 Glass and list the raw materials used in manufacture of glass
- 6.12 Composition of glass
- 6.13 Manufacture of glass
- 6.14 Special types of glasses and its application

## **CHAPTER – VII METALLURGICAL INDUSTRIES**

- 7.1 Methods of manufacturing cast iron and its properties and uses
- 7.2 Manufacture of sponge iron, wrought iron
- 7.3 Different methods of steel manufacturing
- 7.4 Manufacture of alumina from bauxite by Bayer's process
- 7.5 Extraction of aluminum from alumina by Hope's process
- 7.6 Manufacture of rare earth elements like titanium, thorium, uranium & Zirconium and their application.

## **CHAPTER – VIII FERTILIZERS**

- 8.1 Classification of fertilizers
- 8.2 Manufacture of urea, calcium ammonium nitrate, super phosphate and ammonium phosphate, nitrophosphate, sodium phosphate
- 8.3 Mixed fertilizer
- 8.4 Additives used in fertilizers.

### **Reference Books :**

- 1. Chemical Technology by C. Dryden
- 2. Chemical Process Industries by N. Shreeve.

## INDUSTRIAL STOICHIOMETRY

<i>L</i> 3	<i>T</i> 1	<i>P</i> 0		Curri. Ref. No. : CH-305
Total Contact hrs. : 60 <i>Theory</i> : 60			Total Marks : 100	<i>Theory Exam.</i> : 3 hours. <i>End Exam.</i> : 70 Marks I.A. : 20 Marks Assignment:5marks

### Rationale:

In process industries raw materials are processed to get different products. The components present in the raw material combine in a definite proportion and the percentage of product formed depend on various parameters like temperature and pressure etc. It is highly essential to know the stoichiometry ratio and proportions and the process conditions to achieve maximum product formation and recycle of the unused materials for better economy. Therefore, knowledge of stoichiometry is the first and foremost requirement for the success of a chemical engineer.

### Objective :

On completion of study of industrial stoichiometry the student will be able to :

- (i) Differentiate between different units and dimensions, dimensional analysis and solve relevant problems
- (ii) Compare density, specific gravity etc. of gaseous mixtures
- (iii) Estimate quantitative requirement of materials for a chemical reaction
- (iv) Understand the concept of equilibrium vapourization and condensation
- (v) Workout raw material requirement for a chemical process from material balance equation
- (vi) Calculate energy requirement for a chemical process from energy balance equation

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Units and dimension	03	04
2.	Mole Concept	05	10
3.	Stoichiometry	10	10
4.	Gases and Gaseous mixture	10	10
5.	Material balance without chemical reaction	12	13
6.	Material Balance involving chemical reaction	10	13
7.	Energy balance	10	10
	Total	60	70

## **COURSE CONTENT**

### **1.0 UNITS AND DIMENSIONS**

- 1.1 Basic and derived units used in process industry.
- 1.2 Solve numerical on unit conversion from one unit to SI unit.
- 1.3 Dimension and application of dimensional analysis.
- 1.4 Different graphs used in industry.

### **2.0 MOLE CONCEPT**

- 2.1 Mole, mole fraction, mass fraction
- 2.2 Mole concept with respect to chemical equation.
- 2.3 Principle of atom conservation.
- 2.4 Elementary problems on mole concept.
- 2.5 Methods of expressing composition of mixtures and solutions

### **3.0 STOICHIOMETRY**

- 3.1 Stoichiometry.
- 3.2 Basis of Calculation
- 3.3 Concept of limiting reactants.
- 3.4 Atomic weight, molecular weight, molecular formula, empirical formula and solve some problems on it
- 3.5 Solve problems on chemical reaction on mass-mass, mass-volume basis

### **4.0 GASES AND GASEOUS MIXTURES**

- 4.1 Applications of ideal gas .
- 4.2 Average molecular weight, density and composition (by weight and volume) of gas mixture and solve problems on it .
- 4.3 Partial pressure, vapour, Amagat's law, Dalton's law and solve problems on it .
- 4.4 State Roul't's law and Henry's law and solve problems.

### **5.0 MATERIAL BALANCE WITHOUT CHEMICAL REACTION**

- 5.1 State Law of conservation of mass
- 5.2 Concept of material balance
- 5.3 Solve problems on material balance based on Unit operations like mixing, evaporation, distillation, drying, humidification, extraction, absorption

## **6.0 MATERIAL BALANCE INVOLVING CHEMICAL REACTION**

- 6.1 Stoichiometric ratio, stoichiometric proportions, excess reactants, percentage excess, conversion, yield, selectivity.
- 6.2 Concept and reaction mechanism in combustion.
- 6.3 Solve problems on material balance with chemical reaction and combustion.
- 6.4 Concept of recycle and by pass.

## **7.0 ENERGY BALANCE**

- 7.1 Forms of energy.
- 7.2 State law of conservation of energy and explain energy balance
- 7.3 Heat capacity, standard heat of reaction and solve problems on it
- 7.4 Hess's law, Heat of Reaction, Heat of Formation, Heat of Combustion.
- 7.5 Simple problems on calculation of heat of reaction.

### **Reference Books :**

- 1. Chemical process principle, Vol.- I, Hougen and Watson
- 2. Stoichiometry – Bhatt & Vora
- 3. Solved Examples in Chemical Engg. – G. K. Roy.

## INDUSTRIAL CHEMISTRY LAB - I

<i>L</i> 0	<i>T</i> 0	<i>P</i> 3		Curri. Ref. No. : CH-306
Total Contact hrs. : 45 <i>Theory : Nil</i> <i>Practical : 45</i>			Total Marks : 50	<i>Practical Exam. : 4 hrs.</i> <i>Sessional : 25 Marks</i> <i>Practical : 25 Marks</i>

<b>Sl. No.</b>	<b>Topics of experiments</b>	<b>Periods</b>
1.	Perform dry and wet test of radicals	15
2.	Detect unknown salt containing two radicals	06
3.	Determine strength of an unknown acid or base by single titration	06
4.	Determine strength of an unknown acid or base by double titration, use of auto burette	06
5.	Perform oxidation reduction titration involving standardization of potassium permanganate with standard oxalic acid	06
6.	Gravimetric estimation of  (i) Copper as Cupric Oxide (ii) Barium as Barium Sulphate	06

## FLUID MECHANICS LABORATORY

L 0	T 0	P 3		Curriculum Ref. No. : CH-307
Total Contact hrs. : 45 <i>Theory : Nil</i> Practical : 45			Total Marks : 50	<i>Practical Exam. : 4 hrs.</i> <i>Sessional : 25 Marks</i> <i>Practical : 25 Marks</i>

### List of experiments:

1. Demonstrate operation of different types of manometers
2. Demonstrate operation of Reynolds's apparatus and find out critical velocity
3. Verify Bernoulli's equation
4. Demonstrate operation of venturimeter and determine the venturi co-efficient
5. Demonstrate operation of Orifice meter and determine the Orifice co-efficient
6. Determine co-efficient of friction and friction losses in pipes
7. Demonstrate operation of a Rota meter and determine rate of flow through Rota meter
8. Demonstrate the flow over a weir or 'V' notch
9. Demonstrate operation of a fluidized bed column
10. Demonstrate operation of a centrifugal pump and valves
11. Demonstrate operation of Helical Coil and determine pressure drop through the coil.



## MECHANICAL OPERATIONS LABORATORY

<i>L</i> <i>0</i>	<i>T</i> <i>0</i>	<i>P</i> <i>3</i>		Curri. Ref. No. : 308
Total Contact hours. : 45 Practical : 45hours			Total Marks : 50	<i>Sessional : 25 Marks</i>

### List of Experiments :

1. Determine the sphericity of a given sample
2. (a) Demonstrate operation of a Blake type jaw crusher  
(b) Verify Rittinger's Law and the capacity of jaw crusher
3. (a) Demonstrate operation of sieve shaker  
(b) Find out the average size of the product after performing separation size separation by screen analysis
4. Demonstrate operation of vibrating screen & find-out its screen efficiency
5. (a) Demonstrate operation of a Ball mill  
(b) Find-out the critical speed of a ball mill and compare with the actual speed  
(c) Determine the effect the number of balls and time of grinding and plot a graph between the no. of balls Vs. time  
(d) Determine grindability index of a given material.
6. (a) Demonstrate operation of froth flotation cell  
(b) Concentrate the given coal sample and find out the ash present after and before concentration.
7. Perform the batch sedimentation test and plot a graph between height of the dead zone and time.
8. Demonstrate operation of a magnetic separator
9. Demonstrate operation of a centrifuge
10. Demonstrate operation of filter press.
11. Determine operation of a paddle mixer.
12. (a) Demonstrate operation of Wilflay table  
(b) Calculate the efficiency of Wilflay table.
13. Demonstrate operation of cyclone separator and estimate its efficiency
14. Demonstrate operation of a classifier

## CHEMICAL ENGINEERING DRAWING

<i>L</i> 0	<i>T</i> 0	<i>P</i> 3		Curri. Ref. No. : 309
Total Contact hours. : 45 Practical : 45hours			Total Marks : 50	<i>Sessional : 25 Marks</i> <i>Practical Exam. : 25 Marks</i>

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1.	Symbol of Chemical Equipment	10	05
2.	Sketches of Chemical Engineering Equipment	15	10
3.	Process Instrumentation Diagram	20	10
	<b>Total</b>		25

### COURSE CONTENT

#### 1.0 SYMBOLS

1.1 Draw symbols of equipment used in chemical industries

#### 2.0 SKETCH OF CHEMICAL ENGG. EQUIPMENT

- 2.1 Draw sketch of Chemical Engg. Equipment like
- (i) Heat exchanger (double pipe and shell & tube type)
  - (ii) Distillation column
  - (iii) Dryer
  - (iv) Evaporator
  - (v) Ball mill
  - (vi) Cyclone Separator
  - (vii) Crystalliser
  - (viii) Absorber
  - (ix) Extractor

### **3.0 PROCESS INSTRUMENTATION DIAGRAM**

- 3.1 Draw symbols of flow rate indicator, flow recorder, level indicator, pH recorder, level controller,
- 3.2 Draw P.I. diagrams of
  - (i) Cooler temperature control
  - (ii) Reactor temperature control
  - (iii) Heater temperature control
  - (iv) Hot fluid temperature control
  - (v) Evaporator circulation control
  - (vi) Tray dryer control
  - (vii) Top temperature control of distillation column
  - (viii) Control of level and reflux condenser
  - (ix) Steam flow rate and level control of reboiler

#### **Reference Books :**

- 1. Output lines of Chemical Technology : C. Dryden
- 2. Chemical Engineering Drawing : K. A. Ghavane
- 3. Process Equipment Design: Dr Srikant D. Dawande Vol 1 & Vol 2

## COMPUTER APPLICATION - II

<i>L</i> 0	<i>T</i> 0	<i>P</i> 3		Curri. Ref. No. : CH-310
Total Contact hrs. : 45 Theory : Nil		Total Marks : 25		<i>Sessional : 25 Marks</i>

### 1.0 WORKING WITH INTERNET

- 1.1 Surfing Web
- 1.2 Creating E-Mail Account
- 1.3 Using Outlook Express for
- 1.4 Setting up E-Mail Account
- 1.5 Receiving Incoming Message, Sending New E-Mail, Attachment
- 1.6 Using Address Book, Organising and filtering Personal Mail
- 1.7 Understanding E-Mail Etiquette
- 1.8 Sending and receiving faxes
- 1.9 Utilizing Outlook features for Appointment and Events

### 2.0 WORKING WITH Microsoft OFFICE 2007

- 2.1 Understanding Common Office Elements
- 2.2 Working with Common Office Elements
- 2.3 Selecting and editing Text
- 2.4 Setting up E-Mail Account
- 2.5 Using the help of Office Assistant

### 3.0 WORKING WITH Microsoft WORD 2007

- 3.1 Creating, Editing, Handling and printing documents
- 3.2 Formatting Text and working with several documents
- 3.3 Using header, footer, table, chart and application of special features.

### 4.0 WORKING WITH Microsoft EXCEL 2007

- 4.1 Creating, Editing, Formatting, Printing a worksheet
- 4.2 Managing worksheet and data
- 4.3 Using excel formula and functions.
- 4.4 Creating, editing excel diagram and charts

### 5.0 WORKING WITH Microsoft ACCESS 2007

- 5.1 Understanding Data Base Fundamentals
- 5.2 Creating new database and working with existing database
- 5.3 Exploring forms ,quarries and reports

### 6.0 WORKING WITH Microsoft POWER POINT 2007

- 6.1 Creating and editing presentation
- 6.2 Enhancing Slide Show with Animation & Multimedia
- 6.3 Utilizing special features of Power Point 2007

## SOFT SKILL LABORATORY-I

<i>L</i> <i>0</i>	<i>T</i> <i>0</i>	<i>P</i> <i>2</i>		Curri. Ref. No. : CH-311
Total Contact hours. : 30			Total Marks : 25	<i>Sessional : 25 Marks</i>

### Rationale :

The demand for and reliance on soft skills is on increase due to constant change in work environment, customer driven market, information based on economy and globalization. Soft skills are not replacement for hard or technical skill. In fact they are complimentary to each other and served to unlock the potential of people blessed with hard skill. A chemical engineer will work in plants as process engineer, market the chemical product as marketing executive and in many other new areas which require soft skills. Therefore, knowledge of the soft skill, information about soft skill requirement and acquiring soft skills are essential for a student to deal with competition in job market and development in his professional career.

### Objective:

On completion of Practice of Soft skill-1 the student should be able to:

1. understand meaning of soft skill and importance of it in their life.
2. Identify the strength, weakness, opportunity and treat to self.
3. Develop a positive attitude
4. Understand the core value of life and improve perception
5. Develop the art of listening and art of reading
6. Learn about time management

### Topic wise distribution of periods

Sl. No.	Topics	Periods
1	Concept of soft skill	02
2.	Self discovery	04
3.	Developing positive attitude	04
4.	Art of listening	06
5.	Time management	04
6.	Art of reading	06
7.	Improving perception	02
8.	Forming of values	02
	Total	30

## **COURSE CONTENT:**

Classes should be divided into smaller groups of not more than twenty in each group

### **1.0 Concept of Soft Skill**

- 1.1 Importance of Soft skill
- 1.2 Identifying your soft skill
- 1.3 Improving your soft skill

Assignment- Write about your own soft skill, objective of your life, list of soft skill required for improvement.

### **2.0 Self Discovery and SWOT analysis**

- 2.1 Importance of knowing yourself
- 2.2 Using SWOT analysis and its benefits

Assignment- Do SWOT analysis of self and discuss the result with the teacher.

### **3.0 Developing Positive Attitude**

- 3.1 Attitude and behaviour
- 3.2 Developing positive attitude and overcoming negative attitude

Assignment- Study the life story of two great personality from different areas like politics, film, music, writing ,scientist community, social sector, medicine, engineering, sports, arts and explain how positive attitude changed their life.

### **4.0 Art of Listening**

- 4.1 Benefits of active listening
- 4.2 Tips for improvement in listening

Assignment- Practice test on listening and answering questions. Attend a seminar or guest lecturer, listen it carefully and note down the important points and prepare a report of the same.

### **5.0 Time Management**

- 5.1 Realizing the value of time and secret of time management
- 5.2 Time management tips for students

Assignment- Plan your time management and discuss the result with the teacher.

### **6.0 Art of Reading**

- 6.1 Tips for reading
- 6.2 Activities for improving reading rates

Assignment- Practice test on reading and answering questions. Read an article from a magazine and list the important points in 500 words.

### **7.0 Improving perception**

- 7.1 Meaning and factor influencing perception
- 7.2 Improving perception

Assignment- Test your perception and discuss the result with the teacher.

### **8.0 Forming Values**

- 8.1 Types of Value
- 8.2 Importance of value

Assignment- Group Discussion on the importance of moral value in our life.

Reference Book: Soft Skills- Dr K. Alex Second Edition, S. Chand Publication

## TECHNICAL SEMINAR

<i>L</i> <i>0</i>	<i>T</i> <i>0</i>	<i>P</i> <i>2</i>		Curri. Ref. No. : CH-312
Total Contact hrs. : 30			Total Marks : 25	<i>Sessional : 25 Marks</i>

### COURSE CONTENT:

- 1.0** Classes should be divided into smaller groups of not more than four in each group. One group should be assigned a topic for the Seminar. The topic should be usually related to their course of studies or should be of general interest. Every student of the group should prepare on a particular aspect of the main topic with active support and guidance from a teacher guide. The student should be encouraged to extensively use the library facilities and also to collect relevant material from different Technical magazines, journals. Use of internet for information is must and part of seminar valuation. Each student should be usually asked to present his paper on the topic of the Seminar within 15 minutes after which a question answer session may follow for 5 minutes. Senior faculty member should preside over the Seminar and ensure its smooth conduct. The student should be encouraged to use Audio-Visual Aids and prepare power point presentation, other modern teaching methods(models, charts) during presentation of the topics in the Seminar. The Chairman should give the valedictory address and offer suggestions for quality improvement of the Seminar. Each student should at least speak for a minimum of two times during the semester.
- 2.0** The students should be encouraged to collect newspaper clippings and magazine cuttings on emerging technology to be displaced on the date of the seminar.
- 3.0** The Seminar records should be maintained and evaluated by a team of faculty members and the final marks awarded by the team. The evaluation shall include depth of knowledge on topic, presentation skill, question & answer and seminar report.