

Revised Syllabus

*for*

**DIPLOMA IN  
CHEMICAL ENGINEERING**

(III Semester)

**2010**

Developed By

**DIRECTORATE OF TECHNICAL EDUCATION & TRAINING  
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In Collaboration with

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## **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, Defence 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 commensurating 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.	<ul style="list-style-type: none"> <li>- Entrepreneurship Development and Management</li> </ul>

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

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

28. Petrochemical Industries
29. Cement Technology
30. Fertiliser Technology

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		End Exam.	Sessional		
						Class Test	Assignment				
1.	Elementary Mechanical Engineering	3	1	0	80	15	5	-	-	100	
2.	Chemistry I	3	1	-	80	15	5	-	-	100	
3.	Fuels and Furnaces	4	0	-	80	15	5	-	-	100	
4.	Introduction to Chemical Engineering	4	0	-	80	15	5	-	-	100	
5.	Industrial Stoichiometry	3	1	-	80	15	5	-	-	100	
<b>Practical</b>											
1	Chemistry-1	0	0	4	-	-	-	25	25	50	
2	Fuel Technology	0	0	3	-	-	-	25	25	50	
3	Chemical Engineering Drawing	0	0	6	-	-	-	25	50	75	
4	Computer lab- II	0	0	4	-	-	-	25	--	25	
5	Technical Seminar	-	-	2	-	-	-	25	25	50	
<b>Total</b>		<b>17</b>	<b>3</b>	<b>19</b>	<b>400</b>	<b>75</b>	<b>25</b>	<b>125</b>	<b>125</b>	<b>750</b>	

## ELEMENTARY MECHANICAL ENGINEERING

L      T      P  
3      1      0

Curri. Ref. No. : M 301

Total Contact hrs. : 60

Total Marks : 100

**Theory : 100**

Theory : 60

End Term Exam : 80

**Practical: Nil**

I.A. : 20

### Rationale:

Chemical Engineering is intimately related with large areas of mechanical engineering. It is, therefore, essential for a chemical engineer to have basic knowledge of mechanical engineering.

### Objective:

On completion of this subject, student will have basic understanding of the major basic fields of mechanical engineering like Mechanisms, Machines, Thermodynamics and Heat Engines, Machine Tools and Maintenance Engineering.

UNIT	TOPIC/SUB-TOPIC
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### 1.0 CHAPTER - 1

- 1.1 Define shear force & bending moment
- 1.2 Construct shear force & Bending moment diagram of cantilevers, simple supported beam with point load and uniformly distributed load
- 1.3 Determine stresses and deflections of loaded beams

### 2.0 CHAPTER-II

- 2.1 Define machine, mechanism, kinematics, link, kinematics pair, kinematics chain
- 2.2 Illustrate four-bar linkage, crank-connecting rod, quick return mechanism
- 2.3 Understand function of a cam and cam follower

### **3.0 CHAPTER - III**

- 3.1 Determine the length of open belt drive
- 3.2 Determine the ratio of tensions and power transmitted by belt drive
- 3.3 Discuss advantage of rope and chain drives
- 3.4 State working principle of simple brakes & dynamometers
- 3.5 Define & classify bearings (bush and anti-friction)
- 3.6 Explain functions of flywheel & governors.

### **4.0 CHAPTER - 4**

- 4.1 Define heat and work and derive interrelationship
- 4.2 Determine work done by compression and expansion of gases
- 4.3 Explain properties of steam (sensible, latent heat & dryness fraction)
- 4.4 Discuss use of steam tables.

### **5.0 CHAPTER - 5**

- 5.1 Explain function of a boiler
- 5.2 Classify boilers (fire tube, water tube) and explain their working principle
- 5.3 Define IHP, BHP & mechanical efficiency
- 5.4 Define & classify steam turbines (impulse & reaction type)

### **6.0 CHAPTER - 6**

- 6.1 Define and classify internal combustion (I.C.) engine
- 6.2 Explain Otto & diesel cycles
- 6.3 Explain & compare 2 stroke & 4 stroke & I.C. engines
- 6.4 Define IHP, BHP & mechanical efficiency of I.C. engines

### **7.0 CHAPTER - 7**

- 7.1 Define Refrigeration and Air-conditioning and state various applications
- 7.2 Explain simple vapour compression refrigeration system
- 7.3 Explain function and working principle of a gas compressor
- 7.4 State types of refrigerants and explain their properties
- 7.5 Describe the basic concept of air-conditioning with reference to a room air-conditioner

## 8.0 CHAPTER - 8

- 8.1 Define machine tools
- 8.2 Describe different machine tools and their functions (lathe, drill, shaper, milling machine and grinding machine)
- 8.3 Describe types of maintenance (break down, preventive, planned)

### **REFERENCE BOOKS :**

- 1. Applied Mechanics : R. S. Khurmi
- 2. Engineering Thermodynamics : P. L. Balleney
- 3. Refrigeration & Air Conditioning : P. L. Balleney
- 4. Theory of Machine : Thomas Bevan
- 5. Theory of Machine : R. S. Khurmi
- 6. Industrial Engineering & Management : O. P. Khanna
- 7. Elements of Workshop Technology : Hazra Chaudhury, Vol. I & II.

## CHEMISTRY – I

L      T      P  
3      1      0

Curri. Ref. No. :

Total Contact hrs. : 60

Total Marks : 100

Theory : 60

**Theory : 100**

End Term Exam : 80

**Practical : Nil**

I.A. : 15 Assignment: 05

**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 cells
6. Explain role of Colloids

Sl. No.	Topics	Periods	Marks
1	Laws of chemical combination	05	08
2.	Chemical reactions	05	08
3.	Hybridization	08	08
4.	Inorganic compounds	06	06
5.	Solutions	08	12
6.	Electro Chemistry	08	10
7.	Colloids	06	08
8.	Ionic equilibrium	08	08
9.	Radioactivity	06	08
	<b>Total</b>	60	80

## **COURSE CONTENT**

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

- 1.1 State and explain law of definite proportion
- 1.2 State and explain law of multiple proportion
- 1.3 State and explain law of reciprocal proportion
- 1.4 Solve simple problems related to 1.1 to 1.3

### **2.0 CHEMICAL REACTIONS**

- 2.1 Define acids, bases and salts
- 2.2 Write the reactions of acid with salts like nitrate, halides, carbonates

### **3.0 HYBRIDISATION**

- 3.1 Explain hybridization (upto  $SP^3$ )
- 3.2 Concept of sigma and pi bond
- 3.3 Explain VSEPR theory (valence shell electron pair repulsion)
- 3.4 Write structures of  $CH_4$ ,  $C_2H_2$ ,  $C_2H_4$  with respect to hybridization
- 3.5 Explain hydrogen bonding

### **4.0 INORGANIC COMPOUNDS**

- 4.1 Study physical and chemical properties of some inorganic compounds like iron, aluminum, calcium, copper, sulphate, phosphate, nitrate, chlorides..

### **5.0 SOLUTION**

- 5.1 Define ideal solution
- 5.2 State Dalton's law of partial pressure
- 5.3 State Raoult's Law
- 5.4 Explain elevation of boiling point, depression in freezing point and calculate molecular weight of non volatile solute
- 5.5 Explain lowering of vapour pressure
- 5.6 Define osmosis and osmotic pressure
- 5.7 Measure osmotic pressure
- 5.8 State laws of osmotic pressure

## 6.0 **ELECTROCHEMISTRY**

- 6.1 Define electric conductivity; develop the concept of Electrolysis & application of electrolysis.
- 6.2 Explain Faraday's laws of electrolysis and numerical problems on these.
- 6.3 Explain electrochemical cells
- 6.4 State Nearest equation
- 6.5 Primary & secondary cells.
- 6.6 Explain working of lead acid storage cell

## 7.0 **COLLOIDS**

- 7.1 Name and classify different types of colloids
- 7.2 Explain preparation of colloids
- 7.3 Write properties of colloids
- 7.4 Explain purification of colloids
- 7.5 Idea about emulsions.

## 8.0 **IONIC EQUILIBRIUM**

- 8.1 Explain Ostwald Dilution Law
- 8.2 Explain ionic equilibrium
- 8.3 Explain ionisation of water
- 8.4 Explain Hydrolysis
- 8.5 Define common ion effect
- 8.6 Determine pH
- 8.7 Explain theory of indicators
- 8.8 Explain Buffer solutions.
- 8.9 Explain solubility product.

## 9.0 **RADIO ACTIVITY**

- 9.1 Define radioactivity
- 9.2 Compare between alpha, beta and gamma radiation
- 9.3 Explain natural and artificial radioactivity
- 9.4 State Group Displacement Law
- 9.5 Define and compute the half life period of different radioactive element.
- 9.6 Derive the relationship between half life period and rate constant.
- 9.7 Carbon 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

## FUELS AND FURNACES

L      T      P  
4      0      0

Curri. Ref. No. :

Total Contact hrs. : 60  
Theory : 60

Total Marks: 100

Theory Exam. : 3 hrs.  
End Term Exam. : 80  
Marks  
I.A. : 15 Assignment: 05

**Rationale :** Gradual depletion of fossil fuel makes everyone aware of the probable energy crisis in year to come, which is creating awareness about energy conservation in every walk of life. Fuels not only supply energy but also provide basic raw materials for a most of vital industries. It is therefore, understandable why much greater stress should be laid on the knowledge of fuels and different types of furnaces for the benefit of chemical engineering students as compared to those of other branches of engineering.

**Objective :**

After completion of study of Fuels and Furnaces the student will be able to:

- (i) Understand nature and types of solid fuels, origin, chemical composition of coal, calorific value and classification, carbonization and storage of coal,
- (ii) Understand liquid fuels: origin and composition of crude oil, distillation and its products cracking and reforming
- (iii) Understand various types of gaseous fuels, combustion of fuel and elementary principle of combustion etc.

**Topic wise distribution of periods**

Sl. No.	Topics	Periods	Marks
1	Solid fuel	16	12
2.	Liquid fuel	16	12
3.	Gases fuel	06	12
4.	Synthetic fuel	06	08
5.	Nuclear energy and other non conventional sources of energy	05	08
6.	Combustion	06	12
7.	Furnaces	05	16
	<b>Total</b>	60	80

## **COURSE CONTENTS :**

### **CHAPTER - I**

- 1.1 Describe origin of coal
- 1.2 Explain Chemical composition of coal
- 1.3 Define calorific value
- 1.4 Classify coal according to calorific value
- 1.5 Define and classify carbonization of coal
- 1.6 Explain manufacture and properties of metallurgical coke
- 1.7 Describe different methods of storage and washing of coal

### **CHAPTER - II**

- 2.1 Explain origin and composition of crude oil
- 2.2 Describe crude oil distillation and its products
- 2.3 Explain properties and uses of gasoline, kerosene and diesel oil
- 2.4 Define cracking and reforming
- 2.5 Explain processes of cracking and reforming

### **CHAPTER-III**

- 3.1 Explain manufacture, properties, composition and uses of the followings :
  - (i) Natural gas
  - (ii) Coke oven gas
  - (iii) Blast furnace gas
  - (iv) Producer gas

### **CHAPTER – IV**

- 4.1 Explain hydrogenation of coal
- 4.2 Describe fisher-tropsch synthesis

### **CHAPTER - V**

- 5.1 Distinguish between different non conventional energy sources
- 5.2 Explain solar energy, tidal energy, wind energy, geothermal energy and their uses
- 5.3 Explain bio gas, its production and uses
- 5.4 Explain nuclear fuels, production methods and uses

### **CHAPTER - VI**

- 6.1 Explain elementary principles of combustion processes and reactions
- 6.2 Illustrate some simple combustion calculation.

### **CHAPTER - VII**

- 7.1 Classify furnaces and kilns.
- 7.2 Describe different types of kilns and furnaces used in process industries
- 7.3 Describe waste heat recovery systems.

### **Reference Books :**

1. Elements of fuels and furnaces: O. P. Gupta and Sharma
2. Fuels and petroleum processing: B.K. Sharma

## INTRODUCTION TO CHEMICAL ENGINEERING

L      T      P  
3      1      0

Curri. Ref. No. : CH-304

Total Contact hrs. : 60

Total Marks: 100

Theory Exam. : 3 hrs.

Theory : 60

End Exam. : 80 Marks

**Practical: Nil**

**I.A.: 20 Marks**

### Rationale:

This is an introductory subject for the students of Chemical Engineering discipline. Therefore knowledge about various scope of Chemical Engineering, job opportunities, concept of unit operation, industry safety management, operation and maintenance of chemical plant are essential for the success of chemical engineers.

### Objective:

After completion of study of introduction to chemical engineering the student will be able to:

- (i) Understand history and scope of chemical engineering, unit operation and processes, industrial safety management, operation and maintenance of chemical plant.

Sl. No.	Topics	Periods	Marks
1	History and scope of Chemical Engg.	15	15
2.	Concept of unit operation & process	10	15
3.	General site consideration	10	15
4.	Industrial safety management	15	25
5.	Operation and maintenance of chemical plant	05	05
6.	Application of computer	05	05
	<b>Total</b>	60	80

## **CHAPTER – I**

### **History and scope of Chemical Engg.**

- 1.1 Describe history of Chemical Engg. and application of Chemical Engg. Education
- 1.2 Classify different chemical industries
- 1.3 Explain status of different chemical industries with reference to petroleum refining, petrochemicals, Aluminum, steel, fertilizer, chloro alkali, acid, sugar, pulp and paper.
- 1.4 Describe challenges faced by chemical industry and role of chemical engineers
- 1.5 Name different chemical engineering journals and periodicals.

## **CHAPTER - II**

### **2.0 Concept of Unit operation and process**

- 2.1 Define unit operation
- 2.2 Define unit process
- 2.3 Name different choice of process technology
- 2.4 Explain batch and continuous process
- 2.5 Explain flow chart

## **CHAPTER - III**

### **3.0 General site consideration and plant design**

- 3.1 Explain elementary idea about site selection, plant location, plant layout and utilities
- 3.2 Describe elementary idea about environmental consideration, project documentation, code, standard and factor of safety

## **CHAPTER - IV**

### **4.0 Industrial safety management**

- 4.1 State the elementary concept of safety management
- 4.2 Explain cause of accident, chemical hazard
- 4.3 Classify fire and explain fire hazard
- 4.4 Name different personal protective equipment
- 4.5 State and explain elementary principles of first aid
- 4.6 Explain safety education and training
- 4.7 Explain elementary concept of Hazop and Hazon study

## **CHAPTER - V**

### **5.0 Operation and maintenance of Chemical Plant**

- 5.1 Describe introductory idea about operation and maintenance of chemical plant

## **CHAPTER - VI**

### **6.0 Application of Computer**

- 6.1 Explain application of computer in different areas of chemical engineering

### **Reference Books :**

1. Chemical Engineering : Coulson and Richardson (Vol. – 6)
  2. Plant Design and Economics for Chemical Engg. : Peter Timmorhaus
  3. Industrial Safety Management : Tarafdar & Tarafdar
  4. Fundamental of Chemical Engg. : B. N. Saha
  5. Industrial, safety, Health and Environment management system
- .

## INDUSTRIAL STOICHIOMETRY

L      T      P  
3      1      0

Curri. Ref. No. :

Total Contact hrs. : 60

Total Marks : 100

Theory Exam. : 3 hrs.

Theory : 60

End Term Exam. : 80

**Practical: Nil**

Marks

**I.A. : 20 Marks**

### 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.	Gases and Gaseous mixture	10	12
4.	Stoichiometry	10	12
5.	Material balance without chemical reaction	12	15
6.	Material Balance involving chemical reaction	10	15
7.	Energy balance	10	12
	Total	60	80

## **COURSE CONTENT**

### **1.0 UNITS AND DIMENSIONS**

- 1.1 Explain basic and derived units used in process industry.
- 1.2 Solve numerical on unit conversion from one unit to SI unit.
- 1.3 Explain dimension and application of dimensional analysis.
- 1.4 Explain different graphs used in industry.

### **2.0 MOLE CONCEPT**

- 2.1 Define moles, mole fraction, mass fraction
- 2.2 Explain mole concept with respect to chemical equation.
- 2.3 Describe principle of atom conservation.
- 2.4 Solve elementary problems on mole concept.

### **3.0 GASES AND GASEOUS MIXTURES**

- 3.1 Explain applications of ideal gas .
- 3.2 compute average molecular weight, density and composition (by weight and volume) of gas mixture and solve problems on it .
- 3.3 Explain partial pressure, vapour, Amagat's law, Dalton's law and solve problems on it .
- 3.4 State and explain Roul't's law and Henry's law and solve problems.

### **4.0 STOICHIOMETRY**

- 4.1 Define and explain stoichiometry .
- 4.2 Explain basis of Calculation
- 4.3 Explain the concept of limiting reactants .
- 4.4 Define atomic weight, molecular weight, molecular formula, empirical formula and solve some problems on it
- 4.5 Solve problems on chemical reaction on mass-mass, mass-volume basis

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

- 5.1 State Law of conservation of mass
- 5.2 Explain 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 Define and explain stoichiometric ratio, stoichiometric proportions, excess reactants, percentage excess, conversion, yield, selectivity.
- 6.2 Explain the concept and reaction mechanism in combustion.
- 6.3 Solve problems on material balance with chemical reaction and combustion.
- 6.4 Explain recycle and by pass concept and solve problems on it.

## 7.0 **ENERGY BALANCE**

- 7.1 Explain forms of energy.
- 7.2 State law of conservation of energy and explain energy balance
- 7.3 Define heat capacity, standard heat of reaction and solve problems on it
- 7.4 Define 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.

## CHEMISTRY LAB - I

L      T      P  
0      0      4

Curri. Ref. No. :

Total Contact hrs. : 60

Total Marks : 50

Theory : Nil

**Practical : 60**

**Practical Exam. : 4 hrs.**

**Sessional : 25 Marks**

**Practical : 25 Marks**

Sl. No.	Topics of experiments	Periods
1.	Perform dry and wet test of radicals	16
2.	Detect unknown salt containing two radicals	14
3.	Determine strength of an unknown acid or base by single titration	08
4.	Determine strength of an unknown acid or base by double titration	08
5.	Perform oxidation reduction titration involving standardization of potassium permanganate with standard oxalic acid	08
6.	Gravimetric estimation of  (i) Copper as Cupric Oxide (ii) Barium as Barium Sulphate	06

## FUEL TECHNOLOGY LABORATORY

L      T      P  
0      0      3

Curri. Ref. No. :

Total Contact hrs. : 45

Total Marks : 50

Practical Exam. : 4  
hrs.

Theory : Nil

**Practical : 45**

Practical Exam. : 25  
Marks

**Sessi onal : 25**  
**Marks**

Sl. No.	List of Experiments	No. of Periods
1.	Demonstrate operation of muffle furnace	3
2.	Carry out proximate analysis of coal	6
3.	Estimate calorific value of fuel by bomb calorimeter	6
4.	Determine sulphur content of a sample of coal	3
5.	Determine nitrogen content in the coal	6
6.	Determine density and specific gravity of different lubricating oil and liquid fuels	6
7.	Determine flash point of a liquid fuel by flash point apparatus	3
8.	Determine the cloud and pour point of a lubricating oil	3
9.	Determine aniline point of an oil	3
10.	Study Orsat gas analyser and conduct flue gas analysis	6

## CHEMICAL ENGINEERING DRAWING

L      T      P  
0      0      6

Curri. Ref. No. : CH-306

Total Contact hrs. : 90  
Theory : Nil

Total Marks : 50

Sessional : 25 Marks  
End Exam. : 50 Marks

### Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1.	Pipe Fitting and Flange Joints	10	05
2.	Symbol of Chemical Equipment	10	05
3.	Process Flow Sheet	16	10
4.	Utility line diagram	16	05
5.	Engineering Line Diagram	12	10
6.	Sketche and Fabrication Drawing	10	05
7.	Process Instrumentation Diagram	16	10
	<b>Total</b>	90	50

### COURSE CONTENT

#### 1.0 NUTS AND BOLTS

1.1 Draw IS standard hexagonal and square headed nuts and bolts.

#### 2.0 PIPE JOINTS

2.1 Draw symbols of different pipe fittings

2.2 Draw flange joint.

#### 3.0 COUPLING

3.1 Draw orthographic views of knuckle, cotter joint

3.2 Sketch orthographic view of flange coupling

## 4.0 ORTHOGRAPHIC PROJECTIONS

4.1 Draw orthographic projections of simple machines parts

## 5.0 SYMBOLS

5.1 Draw symbols of equipment used in chemical industries

## 6.0 SKETCH OF CHEMICAL ENGG. EQUIPMENT

6.1 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

## 7.0 PROCESS INSTRUMENTATION DIAGRAM

7.1 Draw symbols of flow rate indicator, flow recorder, level indicator, pH recorder, level controller,

7.2 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. Text book of Machine Drawing : R. B. Gupta
4. Machine Drawing : N. D. Bhatt



#### **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