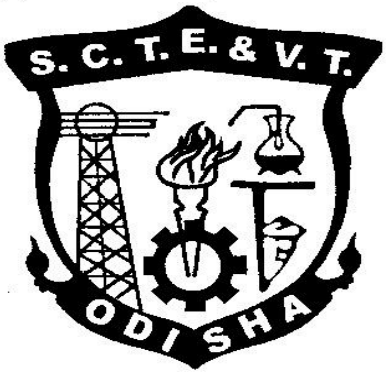
CURRICULLUM OF 6TH SEMESTER

For

DIPLOMA IN CHEMICAL ENGINEERING

(Effective from 2020-21 Sessions)



STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING, ODISHA, BHUBANESWAR

STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

TEACHING AND EVALUATION SCHEME FOR 6th Semester (CHEMICAL)(wef 2020-21)

Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Sem Exams	Exams (Hours)	Total
		Theory							
Th.1		Plant Safety Management*	4	-	-	20	80	3	100
Th.2		Chemical Reaction Engineering	4	-	-	20	80	3	100
Th.3		Petroleum Refining & Petrochemical Technology	4	-	-	20	80	3	100
Th.4		Elective Subject 1.Nobel Separation Process 2.Pharmaceutical Technology 3. Fertiliser & Polymer Technology	4	-	-	20	80	3	100
		Total	*16*	-	-	*80*	*320*	-	*400*
		Practical							
Pr.1		Plant Safety Laboratory	-	-	3	25	25	3	50
Pr.2		Reaction Engineering Laboratory	-	-	3	25	25	3	50
Pr.3		Fuel Technology Laboratory	-	-	3	25	50	3	75
Pr.4		Project Phase II	-	-	9	50	100	-	150
Pr.5		Life Skills	-	-	2	25	-	-	25
		Student Centred Activities(SCA)		-	3	-	-	-	-
		Total	-	-	*23*	*150*	*200*	-	*350*
		Grand Total	**16**	**-**	**23**	**230**	**520**	**-**	**750**

Abbreviations: L-Lecturer, T-Tutorial, P-Practical . Each class is of minimum 55 minutes duration

Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%

SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM/Idea Tinkering and Innovation Lab Practice etc. ,Seminar and SCA shall be conducted in a section.

There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester

Th1. PLANT SAFETY MANAGEMENT

Common to Chemical, Biotechnology & Food Technology

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. **Rationale**:

The present day industrial environment demands increased production, high efficiency, control of cost, stringent quality control. The production processes have become complex and capital intensive. To meet such needs of industries, the subject of safety, health and environment (S,H and E) has attained significance importance. Today safety is an integral part of any industry. The engineers are therefore expected to have firsthand knowledge of this subject.

B. OBJECTIVES:

On completion of study of Plant Safety Management the student will be able to understand

1. Concept of safety management
2. Safe working practice
3. Use of Personal Protective Equipment
4. Fire Prevention & can do Fire Fighting.
5. Understand Chemical Hazards, Mechanical Hazards, Electrical Safety, Electrical Shocks

C. Topic Wise Distribution of Periods

SL. No.	Topics	Period
1	Introduction to Industrial safety management	08
2	Safe working practice	10
3	Personal Protective Equipment	08
4	Fire Prevention & Fire Fighting	08
5	Chemical Hazards	10
6	Electrical Safety, Electrical Shocks & their prevention	10
7	Mechanical Hazards	06
	Total	60

D. COURSE CONTENT

Chapter 1.0 INTRODUCTION TO INDUSTRIAL SAFETY MANAGEMENT

1.1 Fundamental of safety
1.2 Unsafe act and unsafe condition
1.3 Integration of Safety, Health and Environment
1.4 Objective and principle of Safety Management
1.5 Terms and definition used in safety management
1.6 Classification of accidents

Chapter 2.0 SAFE WORKING PRACTICE

2.1 Good Housekeeping practice
2.2 Work place safety
2.3 Safe working environment
2.4 Spot a hazard to stop an accident
2.4 Precaution in use of ladder
2.5 Safety instruction during maintenance
2.6 Safety measures during handling of compressed system, cylinders and painting Equipments
2.7 Permit to work system

Chapter 3.0 PERSONAL PROTECTIVE EQUIPMENTS (PPE)

3.1 Requirement of personal protective equipment
3.2 Classification of Hazards
3.3 Personal protective equipments for different parts of body
3.4 Guideline to use personal protective equipment

Chapter 4.0 FIRE PREVENTION AND FIRE FIGHTING

4.1 Fundamentals of fire, elements of fire.
4.2 Terms and definition in Fire Management.
4.3 Classification of fire and fire extinguishing technique
4.4 Causes of fire and its prevention
4.5 Different types of fire extinguisher and their application
4.6 Precaution for prevention of fire

Chapter 5.0 CHEMICAL HAZARDS

5.1 Classification of Chemical Hazards
5.2 Factors influencing effects of toxic chemicals
5.3 Terms related to concentration level as per industrial hygiene norm
5.4 Control measure for Chemical hazards

Chapter 6.0 ELECTRICAL SAFETY, ELECTRICAL SHOCK AND THEIR PREVENTION

6.1 Introduction to electrical safety
6.2 Precaution and safety in use of electricity
6.3 Electrical hazards in Industrial system
6.4 Safety provision to prevent electrical hazards

Chapter 7.0 MECHANICAL HAZARDS

7.1 Sources of mechanical hazards
7.2 Machine Guard and Safety devices
7.3 Pressure hazards and pressure vessel
7.4 Safety measures in use of gas cylinders
7.5 Types of maintenance (example- Breakdown, preventive)

Syllabus Coverage up to I.A
Chapter 1,2,3

E. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	R.K. Jain, Sunil Rao	Industrial safety Health and Environment System	Khanna Publication
2	Tarafdar & Tarafdar	Industrial Safety Management	Dhanpat Ray & Sons
3	Amit Gupta	Industrial, safety and Environment	Laxmi Publication

Th2. CHEMICAL REACTION ENGINEERING AND CATALYSIS

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. RATIONALE:

This subject is of great importance in chemical engineering profession. It is necessary to study the principles of kinetics and catalysis, which will provide knowledge in understanding chemical reaction mechanisms. The primary purpose of chemical reaction engineering is optimization of chemical reactors, feed composition and operating conditions.

Catalysis is the process of increasing the rate of a chemical reaction by adding a substance known as a catalyst, which is not consumed in the catalyzed reaction and can continue to act repeatedly. Because of this, only very small amounts of catalyst are required to alter the reaction rate in most cases.In general, chemical reactions occur faster in the presence of a catalyst because the catalyst provides an alternative reaction pathway with a lower activation energy than the non-catalyzed mechanism.

B. OBJECTIVES:

After completion of study, the student will be able to

(i) Understand about the rate at which a reaction occur and it's order
(ii) Specify the conditions for the feasibility of a reaction
(iii) Explain the role of catalyst on a chemical reaction
(iv) Differentiate different types of reactors used in chemical industries and their application.

C. Topic Wise Distribution of Periods

Sl. No	TOPICS	Periods
1.	Chemical kinetics	15
2.	Interpretation of Batch Reaction data	20
3.	Catalysis	10
4.	Reactors	10
5	Chemical Equilibrium	05
	TOTAL	**60**

COURSE CONTENT

CHAPTER-1 CHEMICAL KINETICS

1.1 Classification of chemical reaction.
1.2 Rate of reaction, rate constant.
1.3 Elementary and non-elementary reaction.
1.4 Molecularity and order of reaction.
1.5 Arrhenius equation.
1.6 Concept of activation energy.
1.7 Half-life reaction.
1.8 Solve problems to determinerate,order of reaction and activation energy.

CHAPTER-2 INTERPETATION OF BATCH REACTOR DATA

2.1 Derivation of integrated rate equation for irreversible unimolecular type, first-order reaction, irreversible bimolecular type second order reaction.
2.2 Methods of interpretation of Batch reactor data.
2.3 Derivation of equation for constant volume batch reactor.
2.4 Elementery idea about Auto catalytic reaction, reversible reaction,variable volume batch reactor.(no derivation)
2.5 Solve numerical based on topics 2.1 to2.3

CHAPTER-3 CATALYSIS

3.1. Define and classify catalysis with example.
3.2. Characteristics of catalytic reaction.
3.3. Promoter, Inhibitors, Accelerators, carriers and their actions.
3.4. Catalytic poisoning.
3.5. Autocatalysis, negative catalysis, enzyme catalysis.
3.6. Deactivation of catalysis, Activation energy and catalysis.
3.7 Discuss theories of catalysis
3.8 Preparation of catalyst

CHAPTER-4 REACTORS

4.1 Construction and operation of Batch reactors, semi batch reactor, continuous reactor, Tank Reactors, Tubular Reactor,CSTR, Fixed Bed Reactor, Fluidized bed Reactor, Spray column reactor, Packed column Reactor, Reactor with catalyst.
4.2 Basic design equations for batch, CSTR, TFR.
4.3 Space velocity, space-time, and residence time.
4.4 Choice of a reactor and material of construction of reactor.
4.5 Optimum Reactor Design

CHAPTER-5 CHEMICAL EQUILIBRIUM

5.1 Reversible reaction with example.
5.2 Chemical equilibrium, characteristic of chemical equilibrium.
5.3 Law of Mass action, equilibrium constant
5.4 Le Chatelier's Principle.
5.5 Condition for maximum yield in industrial processes

Syllabus Coverage up to I.A
Chapter 1,2,3

E. Books Recommended

Sr no	Name of Author	Title of Book	Name of Publisher
1	J.M Smith	Chemical Kinetics	McGrawhill
2	Octive Levenspiel	Chemical Reaction Engineering	Wiley
3	K A Gavane	Chemical Reaction Engineering Volume-1	Nirali Publication
4	Bahl & Bahl	Essential of Physical Chemistry	S Chand
5	S C Roy	Chemical Reaction Engineering	Dhanpat Rai
6	Y K Mohanty	Theories & Problems in Chemical Reaction Engineering	Khanna
7	Bahl & Bahl	Physical Chemistry	S Chand

TH3. PETROLEUM REFINING & PETROCHEMICAL TECHNOLOGY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. RATIONALE :

Petroleum industry ranks highest of all the chemical industries in India. The demand for refinery products and petrochemicals are increasing day by day. Process so, petroleum refining and production of petrochemicals are very much important for synthetic organic chemical industry. Therefore knowledge of petroleum refinery and petrochemicals are necessary for the success of chemical engineer.

B. Objectives :

After completion of study of Petro Chemical technology,

1. The student will be able to distinguish between petroleum refining process and petrochemical.
2. Understand the concept of synthesis of refinery products, their properties and uses.
3. Understand about growth and future of petroleum refinery and petrochemical industries in India

C. Topic Wise Distribution of Periods

Sl. No.	Topics	Periods
1	Introduction to Petroleum Industries	08
2.	Fractionation of Crude Petroleum Oil	12
3	Pertoleum Refining	12
4	Petroleum Feed Stock- First Generation Petrochemicals	10
5	Second Generation PetroChemicals	10
6	Third Generation Petrochemicals	08
	Total	**60**

Chapter –1 INTRODUCTION TO PETROLEUM INDUSTRIES

1.1 Development and growth of petrochemical industry in India
1.2 Define petrochemicals & describe the importance of petrochemical industry
1.3 Theories on Origin of petroleum, detection and production of petroleum
1.4 Pre treatment of oil before refining, desalting and stabilisation of crude
1.5 Classification and composition of petroleum
1.6 Transportation of crude oil for refining

Chapter-2 FRACTIONATION OF CRUDE PETROLEUM OIL

2.1 Cracking-Principle, necessity and types of cracking
2.2 Reaction and parameters in thermal cracking, pyrolysis, visbreaking and coking
2.3 Catalytic cracking process, parameters, process in different catalytic crackers
2.4 Thermal and catalytic reforming
2.5 Polymerisation, Alkylation and isomerisation

Chapter-3 PETROLEUM REFINING

3.1 Product from a refinery, temperature range and uses of petroleum products
3.2 Crude oil distillation system- Operation in Single, Two, Three stages distillation units
3.3 Flow diagram of an integrated petroleum refinery
3.4 Safety, storage and handling of Petrochemical Products
3.5 Overviews of Refineries in India

Chapter-4 CHEMICAL FEED STOCK-FIRST GENERATION PETROCHEMICALS

4.1 History and growth of Petrochemical industries globally and in India
4.2 Petrochemical feed stock- category, composition and source
4.3 Process of Steam reforming of naphtha
4.4 Separation of C4 cuts from naphtha crackers
4.5 Industrial method of cyclohexane manufacturing

Chapter-5 SECOND GENERATION PETROCHEMICALS

5.1 Manufacturing of methanol, ethanol from synthesis gas
5.2 Manufacturing of vinyl monomer(vinyl chloride, vinyl acetate, Acrylonitrile)
5.2 Manufacturing of Polyester monomer(Terephthalic acid, Phthalic Anhydride)

Chapter-6 THIRD GENERATION PETROCHEMICALS

6.1 Manufacturing of formaldehyde, acetaldehyde, Acetic acid
6.2 Manufacture of BTX(Benzene, Toluene, Xylene),Aniline
6.3 Manufacture of Melamine and linear alkyl benzene

Syllabus Coverage up to I.A
Chapter 1,2,3,4

E. Books Recommended

Sr no	Name of Author	Title of Book	Name of Publisher
1	O P Gupta	Petroleum Refinery Engineering	Khanna
2	Anjana Srivastava	Petrochemicals	Katson
3	B K B Rao	Modern Petroleum Refining Process	Oxford IBH
4	C R Lahani	Petrochemical Industries	CBS
5	Dryden	Outline of Chemical Technology	East West Press

Th4.(a) Nobel Separation Technology(ELECTIVE)

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. RATIONALE :

Membrane technologies have been established as very effective and commercially attractive options for separation and purification processes in the chemical and allied industries dealing with biochemical, pharmaceuticals, petrochemicals, food and beverages and so on. Membranes are now competitive to conventional techniques, by virtue of the facts that they work without addition of chemicals, with a relatively low energy use and in a compact modular design. Therefore, knowledge of membrane technology assumes paramount importance for the success of chemical engineers.

B. **OBJECTIVE:** On completion of study of Nobel Separation Technology the student will be able to understand

1. Nature of membrane, its module, flow pattern
2. Concept of Membrane, type and module
3. Understand concept of Reverse Osmosis, Nano Filtration, Ultra filtration, Micro filtration
4. Understand concept of Gas separation and pervaporation.
5. Understand application of Ion Exchange and other membrane application

C. **Topic Wise Distribution of Periods**

Sl. No.	Topics	Periods
1	Introduction	08
2.	Membrane Type, Module, Flow pattern	10
3.	Reverse Osmosis	10
4.	Nano Filtration, Ultra filtration, Micro filtration	12
5.	Gas separation and pervaporation	10
6.	Ion Exchange and other membrane application	10
	Total	60

D. COURSE CONTENT

Chapter 1.0 INTRODUCTION

1.1 What is a membrane?
1.2 Basic principle of membrane separation
1.3 Classification of membrane processes
1.4 Advantages and disadvantages of membrane processes
1.5 Major application area of membrane separation
1.6 Future processes of membrane separation

Chapter 2.0 MEMBRANE TYPE, MODULE, FLOW PATTERN

2.1 Types of synthetic membrane
2.2 Micro porous membrane, Asymmetric membrane, thin film composite, Electrically charged, inorganic membrane
2.3 Membrane module- Plate and frame, Tubular, Spiral wound, Hallow fiber
2.4 Membrane material and Pore Characteristics
2.5 Types of flow pattern

Chapter 3.0 REVERSE OSMOSIS

3.1 Concept of Osmosis, Determination of osmatic pressure, Thermodynamic consideration of osmosis
3.2 Isotonic solution
3.3 High Pressure and low pressure reverse osmosis
3.4 Advantages and disadvantages of reverse osmosis
3.5 Forward Osmosis- Elementary idea and application
3.5 Membrane plugging
3.6 Application of reverse osmosis

Chapter 4.0 NANO FILTRATION,ULTRA FILTRATION,MICRO FILTRATION

4.1 Principle of Nano filtration.
4.2 Process limitation of Nano filtration.
4.3 Industrial application of Nano filtration
4.4 Principle of Ultra filtration and its advantages
4.5 Ultra filtration vis-à-vis conventional filtration
4.6 Configuration of Ultra filtration unit
4.7 Types of devices in Ultra filtration.
4.8 Factors affecting the performance of Ultra filtration
4.9 Industrial application of Ultra filtration
4.10 Principle of Micro filtration
4.11 Fouling in Micro filtration membrane
4.12 Application of Micro filtration

Chapter 5.0 GAS SEPARATION AND PERVAPORATION

5.1 Basic principle of gas separation
5.2 Membranes for gas separation and Application of Gas separation
5.3 Basic principle of Pervaporation
5.4 Membrane characteristics and mass transfer in pervaporation & Application

Chapter 6.0 ION EXCHANGE AND OTHER MEMBRANE APPLICATION

6.1 Principle of Ion exchange
6.2 Characteristic of ion exchange resin
6.3 Application of ion exchange
6.4 Membrane Distillation
6.5 Membrane reactors

Syllabus Coverage up to I.A

Chapter 1,2,3

E. Books Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	Kausik Nath	Membrane Separation Processes	PHI
2	Mc Cabe & Smith	Unit Operations of Chemical Engineering	McGraw Hill
3	Richardson and Coulson	Chemical Engineering	McGraw Hill

Th4(b)PHARMACEUTICAL TECHNOLOGY (ELECTIVE)

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. Rational:

The progress in the field of Pharmaceutical Industry has been spectacular as substantial technical and scientific growth in the basic sciences has widened its horizons. The recent advances in the field of basic genetics have opened up new vistas, potentials and possibilities. The primary function of the research-based pharmaceutical corporations is to create value by discovering and producing effective medicines, vaccines and services that improve patients' well-being, and can be sold in markets at a profit. Highly proliferating genetic engineering, concepts of bio-cellular synthesis, bioprocesses, immunization, gene cloning for organ culture, monoclonal antibodies as piloting modules in targeted drug delivery, have became reality now. It is expected that pharmaceutical technology will attain a twofold expansion by the turn of this century. Pharmaceutical Industry has boomed in India due to the various reasons like clinical research, research and development related to various vaccines, etc. Various multinational pharmaceutical corporations are outsourcing their research and development activities to India, giving this industry a rise like never before.

B. Objective:

After completion of the study of pharmaceutical technology the student will be able to know about:

1. Significance and growth of pharmaceutical industry
2. the relationship between pharmacy and biotechnology.
3. the different economically important enzymes and their role in industries.
4. gene therapy and its application for the treatment of different diseases.
5. different types of drugs and their process of targeting inside the cell.
6. pharmaceutical applications in cell culture.

C. **Topic Wise Distribution of Periods**

Sl. No.	Topics	Periods
1	Introduction to Pharmacy	05
2.	Drug kinetics and bio pharmaceutics	15
3.	Principles of drug manufacture	15
4.	Biopharmaceuticals	15
5.	Immunogenicity of biopharmaceuticals	10
	Total	60

Chapter 1.0 Introduction to pharmacy

1.1 History of pharmacy
1.2 Pharmaceutical industry & development of drugs
1.3 Some common terms in pharmacy
1.4 Quality management in pharmacy

Chapter 2.0 Drug kinetics and bio pharmaceutics

2.1 Mechanism of drug absorption, distribution, metabolism and excretion
2.2 Factors affecting the ADME process
2.3 Bioequivalence

Chapter3.0 Principles of drug manufacture

3.1 Liquid dosage forms – solutions, suspensions and emulsions
3.2 Topical applications – ointments, creams, suppositories
3.3 Solid dosage forms – powders, granules, capsules, tablets
3.4 Elementary idea about antibiotics, sulpha drugs, analgesics, synthetic drugs on antimalarial and antiTB, vitamins and synthetic harmones.

Chapter4.0 Biopharmaceuticals

4.1 Principles of pharmacology
4.2 Pharmacokinetics and Pharmacodynamics.
4.3 Study of a few classes of therapeutics like Recombinant therapeutics, Monoclonal Antibodies, Vaccines, Gene therapy, Antibiotics and Hormones.

Chapter 5.0 Immunogenicity of biopharmaceuticals

5.1 Immunogenicity
5.2 Factors contributing to immunogenicity (product related factors, host-related factors)
5.3 Case studies: Erythropoietin, Insulin, DNase, Factor VIIa, Factor IX, Activated protein C, Monoclonal antibodies etc.

E. Books Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	S P Vyas	Pharmaceutical Biotechnology	CBS
2	H D Kumar	Molecular Biology	Vikash Publishing
3	C Dryden	Outline of Chemical Technology	East West Press

Th4(c)FERTILISER AND POLYMER TECHNOLOGY (ELECTIVE)

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	6th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Maximum Marks:	100	End Semester Examination Marks	80

A. Rational:

In India, agriculture is the largest sector of economic activity. It provides food, raw materials and above all, the employment to a very large proportion of population. The national output depends on the output in agriculture, as it is one of the most dominating sectors in India. Fertilizers play an important role in the development of crops by providing the required nutrients for plants to grow. As a result, they may also improve the quality of crops. Also, fertilizers also help in improving farmers' crop yield. The main objective of the fertilizer industry is to ensure the supply of primary and secondary nutrients in the required quantities. Indian fertilizer industry is one of the largest in the world and has played significant role in the development of agriculture in the country.

Polymer is a substance consisting of very large molecules or macromolecules, composed of many repeating subunits. Polymers, both natural and synthetic, are created via polymerization of many small molecules, known as monomers. Their consequently large molecular mass, relative to small molecule compounds, produces unique physical properties including toughness, high elasticity, viscoelasticity. In the commercial production of plastics, elastomers, man-made fibres, adhesives, and surface coatings, a tremendous variety of polymers are used.

B. Objective:

After completion of the study of Fertiliser and Polymer technology the student will be able to know about:

1. Significance and growth of Fertiliser and polymer industry
2. Use reactions and unit operations steps in manufacturing of various fertilizers.
3. Characterize fertilizers on the basis of different properties.
4. Identify engineering problems in fertilizer manufacturing.
5. Understand the concept and techniques used in polymerisation.
6. Know the preparation and application of industrially important polymers.

C. Topic Wise Distribution of Periods

Sl. No.	Topics	Periods
1	Introduction Fertilizer Industry	10
2.	Phosphorous Industry	10
3.	Bio Fertilizers	10
4.	Introduction to Polymers	15
5.	Industrial Polymer and their importance	15
	Total	60

Chapter 1.0 Introduction to Fertilizer Industry

1.1 Major components in fertilizer and its importance
1.2 Overview of Fertilizer plants in India
1.3 Classification of fertilizers
1.4 Feed Stock for Fertilizer Industry

Chapter 2.0 Phosphorous Industry

2.1 Manufacture of phosphoric acid by electric furnace method
2.2 Manufacture of phosphoric acid by strong acid process
2.3 Manufacture of phosphoric acid by HCl leaching
2.4 Manufacture of Calcium Phosphate and calcium triple phosphate

Chapter3.0 Bio fertilizer

3.1 Types of Bio fertilizer
3.2 Nitrogen Fixing Bio fertilizer
3.3 Phosphate solubilizing biofertilizer
3.4 Manufacture of Bio Fertilizer

Chapter4.0 Introduction to Polymer

4.1 Polymer and their classification and uses
4.2 Advantages and disadvantages of polymer with traditional materials.
4.3 Polymerization- Types, reactions and examples.
4.4 Polymerisation techniques
4.5 Structure and Technological function of polymer- Fibers,Elastomers,plastics
4.6 Additives for polymers and their importance
4.7 Degradation of polymers

Chapter 5.0 Industrial Polymers and their importance

5.1 Preparation(no flowsheet),Properties and uses of LDPE,HDPE,PP,PVC, CPVC, Polyvinyl Acetate, Polystyrene, Polyvinyl Merthacrylate, Teflon,
5.2 Preparation(no flowsheet),Properties and uses of Nylon-6,Nylon-6:6,PET, PET, Kelvar,
5.3 Preparation(no flowsheet),Properties and uses of Alkyd resins, Phenolic resins, amino resins and Epoxyresins
5.4 Elastomers- Preparation(no flowsheet),Properties and uses of Polyurethane, Neoprene, Butyl rubber, Polysulphide rubber
5.5 Biopolymers-Types and uses
5.6 Growth of polymer industry in India

E. Books Recommended

Sr no	Name of Author	Title of Book	Name of Publisher
1	C Dryden	Outline of Chemical Technology	East West Press
2	Chawla	A Text book Of Engineering Chemistry	Dhanpat Rai
3	G T Austin	Shreve's Chemical Process Industries	McGraw Hill
4	G N Pandey	Chemical Technology Volume-I and II	Sangam Books
5	Open source learning from Internet		

Pr1. PLANT SAFETY MANAGEMENT LABORATORY

Common to Chemical, Biotechnology & Food Technology

Practical:3 Periods per Week	Sessional: 25 marks
Total periods:45 Periods	Practical Examination: 25 marks
Examination: 3 Hours	Total Marks: 50 Marks

A. Rationale:

Workplace safety is very important for each and every employee in the industry because all the workers desire to work in a safe and protected atmosphere. Health and safety is the key factor for all the industries in order to promote the wellness of both employees and employers. It is a duty and moral responsibility of the company to look after the employee's protection.

Students will learn the to use basic safety equipments used in industry through practically using it in Laboratory

B. **Objectives :**

After completion of Practical of Plant Safety Management Practice, the student will be able to :

1. Use personal protective equipment properly in work place
2. Understand the understand the causes of industrial disaster
3. Can distinguigh types of fire and can extinguish small scale fire
4. Provide firstaid to accident victims

EXPERIMENT Wise Distribution of Periods

SL. No.	Experiment	Period
1	Demonstration of Personal Protective Equipment such as Nose Mask, various types of Safety goggles etc	06
2	Use of Fire extinguisher	09
3	Hazop and Hazon Study	06
4	Analysis of cases of Industrial disaster	03
5	Study on latest advances in PPE	06
6	First Aid Training	15
	Total	45

Pr2. REACTION ENGINEERING LAB

Practical:3 Periods per Week	Sessional: 25 marks
Total periods:45 Periods	Practical Examination: 25 marks
Examination: 3 Hours	Total Marks: 50 Marks

A. Rationale:

In the modern chemical industry, the aim is to achieve high-quality products and minimise unwanted by-products. Selectivity in the reactor is particularly important in processes in which by-products cause environmental problems. Every industrial chemical process is designed to produce economically a desired product from a variety of starting materials through a succession of treatment steps. The raw materials undergo a number of physical treatment steps to put them in the form in which they can be reacted chemically. Then they pass through the reactor. The products of the reaction must then undergo further physical treatment - separation, purification, etc - for the final desired product to be obtained. Knowledge of the advantages and drawbacks of chemical reactor properties is therefore essential for all chemical and biochemical processes.

Students will learn the kinetics of reaction through practically using laboratory equipments used in the process industry.

B. **Objectives :**

After completion of Practical of Reaction Engineering, the student will be able to :

1. Understand working, construction and operation of different reactors used in industry
2. Understand the principle of kinetics of reactions used in the Process industry

Experiment Wise Distribution of Periods

Sl .No.	Experiment	Period
1	To determine the value of rate constant for the hydrolysis of ethyl acetate catalysed by hydrochloric acid	06
2	To study the hydrolysis of ester(ethyl acetate) by alkali (NaOH).Show the reaction is kinetically second order. Also calculate the velocity constant	06
3	To calculate value of rate constant “K” for the saponification of ethyl acetate with NaOH in batch reactor-I (where M=1)	06
4	To calculate value of rate constant “K” for the saponification of ethyl acetate with NaOH in TFR.	06
5	To calculate value of rate constant “K” for the saponification of ethyl acetate with NaOH in Continuous Stirred Tank Reactor	06
6	To calculate value of rate constant “K” for the saponification of ethyl acetate with NaOH in packed bed reactor	06
7	To calculate value of rate constant “K” for the saponification of ethyl acetate with NaOH in CSTR in series	09
	Total	**45**

Pr.3 FUEL TECHNOLOGY LABORATORY

Practical:3 Periods per Week	Sessional: 25 marks
Total periods:45 Periods	Practical Examination: 50 marks
Examination: 3 Hours	Total Marks: 75 Marks

A. Rationale:

Fuel is one of the most widely-used sources of energy in the world today. Most fuels are natural substances such as coal, petro fuel, diesel, and natural gas, which are either extracted straight from the earth or produced by refining substances such as petroleum. The energy produced by burning fuel has many applications, such as powering vehicles, ships, and airplanes as well as providing electricity for homes and buildings. Some common types of fuels are petro fuel, gas oil, diesel fuel, fuel oils, aviation fuel, jet fuel, and marine fuels. So it is important to learn the properties of fuel for its right use as well as to ensure quality of fuel.

Students will learn the properties of different fuels and its significance through practical by using Laboratory equipments used in the process industry.

B. **Objectives :**

After completion of Practical of Mass transfer-2, the student will be able to :

1. Understand construction and operation of muffle furnace, bomb calorimeter, flash point apparatus, aniline point apparatus used in industry
2. Understand the laboratory skill of analysis of properties of fuel used in the Process industry

Experiment Wise Distribution of Periods

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 calori meter	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
	Total	45

Pr4. PROJECT Phase - II

Name of the Course: Diploma in Chemical Engineering			
Course code:		Semester	6th
Total Period:	135	Examination	3 hrs
Lab. periods:	9 P / week	Sessional	50
Maximum marks:	150	End Sem Examination	100

RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Chemical engineering and practices in real life situations, so as to participate and manage a large Chemical engineering projects, in future. Entire Project spreads over 5th and 6th Semester. Part of the Project covered in 5th Semester was named as *Project Phase-I* and balance portion to be covered in 6th Semester shall be named as *Project Phase-II*.

OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Develop software packages or applications and implement these for the actual needs of the community/industry.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- To achieve real life experience in Project design.

- To develop the skill of writing Project Report

Project Phase-I and Phase-II

The Project work duration covers 2 semesters(5^{th} and 6^{th} sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group was done in the beginning of 5^{th} semester under Project Phase-I. The students were allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system also have to be complete in Phase-I. Development may also begin in this phase. Project Milestones are to be set so that progress can be tracked .

In Phase-II Development, Testing, Documentation and Implementation have to be complete. Project Report have to be prepared and complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the components of Task and schedule.

At the end of Project Phase-II in 6^{th} semester there shall be one presentation by each group on whole Project work undertaken by them.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	**Performance Criteria**
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance
4.	Providing solution of the problems or production of final product
5.	Sense of responsibility
6.	Self expression/ communication/ Presentation skills
7.	Interpersonal skills/human relations
8.	Report writing skills
9	Viva voce

The teachers are free to evolve other criteria of assessment, depending upon the type of project

work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations to such an exhibition.

The Project Report need to be prepared as per standard format and following is the indicative format. The Teacher Guide may make minor alteration keeping the sense in tact.

Organization of Project Report

1. Cover page:
   It should contain the following (in order)

   (i) Title of the Project
   (ii) "Submitted in partial fulfillment of the requirements for the Diploma in <Branch Name>"
   (iii) By Name of the Student(s)
   (iv) Logo of the Institution
   (v) Branch Name/Depart Name and Institution Name with Address
   (vi) Academic Year
2. 1st Inner page
   Certificate:

   It should contain he following

   "This is to certify that the work in this Project Report entitled <Project Title> by <Name of student(s)> has been carried out under my supervision in partial fulfillment of the requirements for the Diploma in <Branch Name>" during session <session > in <Branch /Department Name> of <Institute name> and this work is the original work of the above student(s).

   Seal and signature of the Supervisor/Guide with date

3. 2nd Inner Page
   Acknowledgement by the Student(s)

4. Contents.
5. Chapter wise arrangement of Reports
6. Last Chapter: Conclusion
   It should contain

   (i) Conclusion
   (ii) Limitations
   (iii) Scope for further Improvement
7. References

Pr-5 LIFE SKILL

(Common to All Branches)

Practical	**2 Periods per week**	**Sessional**	**25 Marks**
Total Periods	**30 Periods**	**Total Marks**	**25 Marks**

Objective: After completion of this course the student will be able to**:**

- Develop team spirit i.e. concept of working in team
- Apply problem solving skills for a given situation
- Use effective presentation techniques
- Apply task management techniques for given projects
- Enhance leadership traits
- Resolve conflict by appropriate method
- Survive self in today's competitive world
- Face interview without fear

DETAIL CONTENTS:

1. SOCIAL SKILL

Society, Social Structure, Develop Sympathy and Empathy
Swot Analysis – Concept, How to make use of SWOT
Inter personal Relation**:** Sources of conflict, Resolution of conflict ,
Ways to enhance interpersonal relation

2. PROBLEM SOLVING

Steps of Problem solving**:**

- Identify and clarify the problem,
- Information gathering related to problem,
- Evaluate the evidence,
- Consider alternative solutions and their implications,
- Choose and implement the best alternative,
- Review
- Problem solving techniques:

1) Trial and error, 2) Brain storming, 3) Lateral (Out of Box) thinking

3. PRESENTATION SKILL

Body language , Dress like the audience
Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,
Voice and language – Volume, Pitch, Inflection, Speed, Pause
Pronunciation, Articulation, Language, Practice of speech.
Use of AV aids such as Laptop with LCD projector, white board etc.

4. GROUP DISCUSSION AND INTERVIEW TECHNIQUES

Group Discussion:
Introduction to group discussion, Ways to carry out group discussion,
Parameters— Contact, body language, analytical and logical thinking,
decision making
Interview Technique :
Dress, Posture, Gestures, facial expression, Approach
Tips for handling common questions.

5. WORKING IN TEAM

Understand and work within the dynamics of a groups.
Tips to work effectively in teams,
Establish good rapport, interest with others and work effectively with them
to meet common objectives,
Tips to provide and accept feedback in a constructive and considerate way ,
Leadership in teams, Handling frustrations in group.

6. TASK MANAGEMENT

Introduction, Task identification, Task planning ,
organizing and execution, Closing the task

PRACTICAL

List of Assignment: *(Any Five to be performed including Mock Interview)*

1. **SWOT analysis:-**
   Analyse yourself with respect to your strength and weaknesses, opportunities and threats. Following points will be useful for doing SWOT.

a) Your past experiences,
b) Achievements,
c) Failures,
d) Feedback from others etc.

2. **Solve the True life problem assigned by the Teacher.**

3. **Working in a Team**
   Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc.(One activity per group where Team work shall be exhibited)
4. **Mock Interview**
5. **Discuss a topic in a group and prepare minutes of discussion.**
6. **Deliver a seminar for 5 minutes using presentation aids on the topic given by your teacher.**
7. **Task Management**

Decide any task to be completed in a stipulated time with the help of teacher. Write a report considering various steps in task management (with Break up into sub tasks and their interdependencies and Time)

Note: -1. Please note that these are the suggested assignments on given contents/topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic.
Note: -2. The following Topics may be considered for Seminar/GD in addition to other Topics at the discretion of the Teacher.

(Comparison with developed countries, Occupational Safety, Health Hazard, Accident & Safety, First-Aid, Traffic Rules, Global Warming, Pollution, Environment, Labour Welfare Legislation, Labour Welfare Acts, Child Labour Issues, Gender Sensitisation ,Harassment of Women at Workplace)

METHODOLOGY:

The Teacher is to explain the concepts prescribed in the contents of the syllabus and then assign different Exercises under Practical to the students to perform.

Books Recommended:-

Sl.No	Name of Authors	Title of the Book	Name of the Publisher
01	E.H. Mc Grath , S.J	Basic Managerial Skills for All	PHI
02	Lowe and Phil	Creativity and problem solving	Kogan Page (I) P Ltd
03	Adair, J	Decision making & Problem Solving	Orient Longman
04	Bishop , Sue	Develop Your Assertiveness	Kogan Page India
05	Allen Pease	Body Language	Sudha Publications Pvt. Ltd.

Equipment List

CHEMICAL ENGINEERING SEMESTER-6

PLANT SAFETY MANAGEMENT LABORATORY		
Sr	Name of equipment with specification	Quantity per student strength up to 60
1	Personal protective equipment for head, eye, ear protection	01 set
2	Fire extinguisher-CO_2 type, dry powder type	02 no each
3	First Aid kit	04 set
REACTION ENGINEERING LABORATORY		
Sr	Name of equipment with specification	Quantity per student strength up to 60
1	Conical flask-100ml, 250ml,500 ml	02
2	Volumetric flask-100ml, 250ml	02 no each
3	Burrete-50 ml with complete fitting	02 no each
4	Reagent bottle-250ml	05 no
5	Funnel- different size	02 no
6	Beaker-250 ml and 500 ml	05 no
7	Pipette- 10 ml, 25 ml	05 no
8	Measuring cylinder-10 ml,50 ml,100 ml	01each
9	Batch Reactor laboratory model	01each
10	Tubular Flow Reactor laboratory model	01each
11	Continuous Stirred Tank Reactor laboratory model	01each
12	Packed bed reactor laboratory model	01each
13	CSTR in series laboratory model	01each
FUEL TECHNOLOGY LABORATORY		
Sr	Name of equipment with specification	Quantity per student strength up to 60
1	Conical flask-100ml, 250ml,500 ml	02
2	Volumetric flask-100ml, 250ml	02 no each
3	Burrete-50 ml with complete fitting	02 no each
4	Reagent bottle-250ml	05 no
5	Funnel- different size	02 no
6	Beaker-250 ml and 500 ml	05 no
7	Pipette- 10 ml, 25 ml	05 no
8	Measuring cylinder-10 ml,50 ml,100 ml	01no
9	Crucible-heat resistant	05 no
10	Digital balance	01no
11	Muffle Furnace	01no
12	Aniline point apparatus	01no
13	Bomb Calorimeter set up	01no
14	Flash point apparatus	01no
15	Cloud point apparatus	01no
16	Orsat gas analysis apparatus	01no
17	Specific gravity bottle	01 no