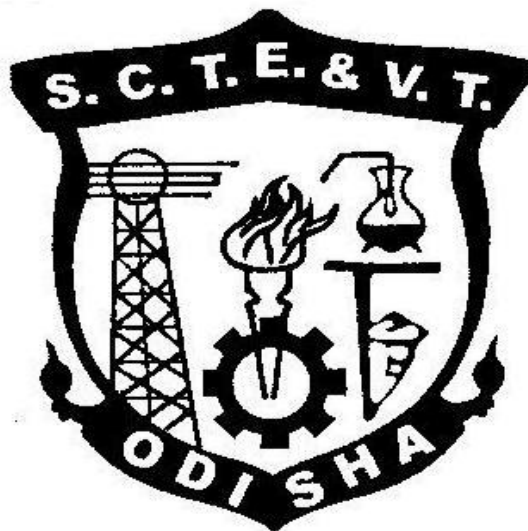


**CURRICULLUM OF 4th SEMESTER
FOR
DIPLOMA IN CHEMICAL ENGINEERING
(W.E.F 2019-20 SESSION)**



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

STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

TEACHING AND EVALUATION SCHEME FOR 4th Semester (CHEMICAL ENGG.)(wef 2019-20)

Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Semester Exams	Exams (Hours)	Total
Theory									
Th.1		Organic Chemistry(C)	3	1	-	20	80	3	100
Th.2		Heat Transfer	3	1	-	20	80	3	100
Th.3		Mass Transfer-1	3	1	-	20	80	3	100
Th.4		Chemical Process Industries-1	4	-	-	20	80	3	100
		<i>Total</i>	13	3	-	80	320	-	400
Practical									
Pr.1		Organic Chemistry Laboratory(C)	-	-	5	50	50	3	100
Pr.2		Heat Transfer Laboratory	-	-	5	50	50	3	100
Pr.3		Mass Transfer-1 Laboratory	-	-	5	50	50	3	100
Pr.4		Chemical Technology Laboratory-1	-	-	5	25	25	3	50
		Student Centered Activities(SCA)	-	-	3	-	-	-	-
		<i>Total</i>	-	-	23	175	175	-	350
		Grand Total	13	3	23	255	495	-	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 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

Th-1 ORGANIC CHEMISTRY

Common to Chemical, Biotechnology & Food Technology

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Tutorial	1P/ Week	End Semester Examination Marks	80
Maximum Marks:	100		

A. Rationale:

Study of organic chemistry as a separate subject is more practical and fruitful. The knowledge of structure and function of a large number of compounds built of relatively few elements is important for future bio-technologist, food technologist and chemical engineer.

B. Objective:

On completion of study of Organic Chemistry, the student will be able to:

1. Name organic compound in IUPAC system
2. Understand the concept of isomerisation
3. Acquaint themselves with methods preparation, properties and use of common aromatic and aliphatic compounds.
4. Acquire knowledge carbohydrates, proteins and amino acids.

C.	Topic wise distribution of periods	
Sl. No.	Topics	Periods
1	Nomenclature	08
2.	Aliphatic Compounds	20
3.	Aromatic Compounds	09
4.	Carbohydrates, Proteins & fats	23
	Total	60

COURSE CONTENT

1.0 IUPAC NOMENCLATURE

- 1.1 Scope of organic chemistry
- 1.2 Differentiate between organic compound and inorganic compounds
- 1.3 Importance of organic Chemistry in modern life.
- 1.4 Classification and sources of organic compounds
- 1.5 IUPAC naming of mono functional and poly functional Organic Compound.
- 1.6 Concept, type and example of isomerism

2.0 ALIPHATIC COMPOUNDS

- 2.1 Methods of preparations, properties and uses of CH₄ and C₂H₆.
- 2.2 Methods of preparations properties of ethylene.
- 2.3 Methods of preparation, properties and uses of acetylene.
- 2.4 Methods of preparation properties and uses of methanol and ethanol.
- 2.5 Absolute alcohol and denatured alcohol.
- 2.6 Methods of preparation properties and uses of formic acid and acetic acid.
- 2.7 Methods of preparation properties and uses of formaldehyde and acetone.

3.0 AROMATIC COMPOUNDS

- 3.1 Methods of preparation, properties and uses of
(a) Benzene (b) Toluene
- 3.2 Methods of preparation, properties and uses of Benzene derivative compound
(a) Phenol (b) Benzaldehyde

4.0 CARBOHYDRATES, PROTEINS & FATS

- 4.1 Classification of carbohydrates
- 4.2 Synthesis and inter conversions of monosaccharides
- 4.3 Manufacturing properties and uses of glucose, fructose, sucrose, and starch.
- 4.4 Preparation, properties and uses of Amino acid
- 4.5 Classification of proteins, Peptides
- 4.6 Properties and uses of proteins.
- 4.7 Sources, Properties and uses of fats.

Syllabus Coverage up to I.A

Chapter 1,2

E. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	B.S. Bahl, Arun Bahl	A Text Book of Organic Chemistry	S Chand Publication

Th-2 HEAT TRANSFER

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Tutorial	1P/ Week	End Semester Examination Marks	80
Maximum Marks:	100		

A. Rationale:

The study of heat transfer helps you to understand how to determine the transfer of heat which we use by means of conduction, convection, radiation in the process for manufacturing of products. Heat is generated as wastage at every energy conversation/system. If someone has proper knowledge about heat transfer, he can easily increase efficiency of any system which is crucial for every process. Now a days, world is more conscious about energy conservation. So, as an engineer it is important to have a stable process with low energy consumption and cost effective.

B. OBJECTIVES:

After completion of the study of Heat Transfer the student will be able to

- 1) Distinguish the fundamental & derived units in heat transfer
- 2) Derive dimensional formula of variables in Heat Transfer.
- 3) Understand and explain various modes of Heat Transfer.
- 4) Acquaint themselves with various problems on Heat Transfer.
- 5) Understand the operation of Heat Exchanger of shell and tube, multi pass and single Pass type.
- 6) Understand the principles of evaporation and operation of evaporators.
- 7) Solve simple heat transfer problems.

C.	Topic Wise Distribution of Periods	
SL. No.	Topics	Period
1	Conduction	15
2	Convection & Heat Exchanger	20
3	Radiation	10
4	Evaporation	15
	Total	60

D. Chapter – 1 CONDUCTION

- 1.1 Heat flow concept in conduction.
- 1.2 Steady state and unsteady state heat flow.
- 1.3 State Fourier's law of conduction.
- 1.4 Heat flow through single material
- 1.5 Heat flow through composite walls.
- 1.6 Heat flow through cylinder
- 1.7 Heat flow through spheres.
- 1.8 Heat flow in single and series medium.
- 1.9 Thermal insulation and critical radius of insulation
- 1.10 Solve simple numerical problems on conduction

Chapter – 2 CONVECTION and HEAT EXCHANGER

- 2.1 Concept of heat flow by convection
- 2.2 Natural and forced convection
- 2.3 Individual and overall heat transfer co efficient
- 2.4 Application of dimensional analysis in Convection
- 2.5 Use Empirical equations for different flow regime
- 2.6 Parallels, co current and counter current flow
- 2.7 Log mean temperature difference
- 2.8 Classify heat exchanger
- 2.9 Construction and working of shell and tube heat exchanger
- 2.10 Multi pass and single pass heat exchanger
- 2.11 Derive energy balance for shell and tube heat exchanger (simple problems)
- 2.12 Construction and operation of Finned tube heat exchanger, Plate type heat exchanger, Scrapped surface heat exchanger
- 2.13 Heat transfer in agitated vessel
- 2.14 Define condensation
- 2.15 Drop wise and film type condensation
- 2.16 Solve simple numerical problems.

Chapter – 3 RADIATION

- 3.1 Principle in radiation heat transfer
- 3.2 Concept of black body, Gray body and emissivity
- 3.3 Mono chromatic emissive power, Derivation of total emissive power
- 3.4 State Kirchoff's Law
- 3.5 State Stefan Boltzmann's Law.
- 3.6 State Wien's law and Plank's law
- 3.7 Estimate heat transfer by radiation

Chapter – 4 EVAPORATION

- 4.1 Objective of Evaporation
- 4.2 Performance, capacity, economy of evaporator
- 4.3 Differentiate among various types of evaporators
- 4.4 Construction and operation of standard basket evaporator , long tube forced circulation type evaporator
- 4.5 Elementary principle of single and multiple effect evaporators
- 4.6 Material and energy balance of single effect evaporators
- 4.7 Solve simple problems on evaporators
- 4.8 Boiling point elevation, Vapour recompression, mechanical recompression and thermal recompression.

Syllabus Coverage up to I.A

Chapter 1,2

E. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	Mc Cabe & J M Smith	Unit operation of Chemical Engineering	Tata Mc Grawhill
2	Badgero and Banchero	Introduction to Chemical Engineering	Tata Mc Grawhill
3	K Gavane	Unit operations II	Nirali Publication

Th. 3 MASS TRANSFER – I

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	60	Examination	3 hours
Theory Periods:	4P/Week	Class Test Marks:	20
Tutorial	1P/ Week	End Semester Examination Marks	80
Maximum Marks:	100		

A. Rationale:

There are many operations in chemical engineering practices involve transfer of mass of a material from one phase (e.g. liquid) to the other phase (e.g. gaseous) associated with or without chemical reactions. Mass transfer operations such as distillation, absorption, adsorption, humidification & de-humidification, drying, extraction, crystallization, ion exchange and membrane separation are often found to constitute the most important amongst the unit operation comprising in a particular process industry. Therefore, it is very important for a chemical engineer to have an idea on the fundamental principles underlying various mass-transfer operations as also understand the working principles and construction of many types of equipment effecting mass transfer in industrial situation.

B. Objective:

On completion of mass transfer-I the students will be able to:

1. Understand Fundamentals of mass transfer operation
2. Explain the principles used in different mass transfer operation
3. Understand the working principle and maintenance of various equipments used in different mass transfer operations like distillation, absorption and adsorption

C. Topic wise distribution of periods		
Sl. No.	Topics	Periods
1	Fundamentals of mass transfer	10
2.	Distillation	25
3.	Absorption	15
4.	Adsorption	10
	Total	60

COURSE CONTENTS :

D. CHAPTER – I FUNDAMENTALS OF MASS TRANSFER

- 1.1 Importance of mass transfer operations
- 1.2 General principle of mass transfer operations
- 1.3 Classify mass transfer operations
- 1.4 Molecular diffusion and inter phase diffusion
- 1.5 Diffusion in gases and liquids
- 1.6 Explain Fick's law & mass transfer coefficient

CHAPTER – II DISTILLATION

- 2.1 Types of boiling point diagrams and enthalpy concentration diagrams
- 2.2 Vapour liquid equilibrium
- 2.3 Relative volatility and derive an expression between ∞ & x-y
- 2.4 Draw XY data (equilibrium curve) for different system in graph paper
- 2.5 Simple distillation & Derivation of Rayleigh's equation (solve simple problems)
- 2.6 Flash distillation and material balance in flash distillation
- 2.7 Continuous rectification of binary system
- 2.8 Construction of rectification column
- 2.9 Types of trays & re-boiler
- 2.10 Channeling, weeping, entrainment and flooding
- 2.11 Analyze fractionating column by McCabe and Thiele Method and find out feed plate location (solve simple problems)
- 2.12 Reflux ratio and concept of minimum, optimum and total reflux ratio
- 2.13 Plate efficiency, Murphee's efficiency
- 2.14 Steam distillation and its application
- 2.15 Azeotropic distillation and extractive distillation.

CHAPTER – III ABSORPTION

- 3.1 Principles of absorption and factors affecting rates of absorption
- 3.2 Different equipments used for absorption
- 3.3 Types of packing materials used in absorption, explain regular and random packing
- 3.4 Loading, flooding and its effect on pressure drop, minimum gas-liquid ratio, HETP
- 3.5 Elementary ideas about spray tower and wetted wall column

CHAPTER – IV ADSORPTION

- 4.1 The principles of adsorption and types of adsorption and factors affecting adsorption
- 4.2 The different types of adsorbents and nature of adsorbents
- 4.3 Elutriation, percolation and industrial application of adsorption
- 4.5 Construction and operation of Industrial adsorption equipment

Syllabus Coverage up to I.A

Chapter 1,2

E. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	Mc Cabe & J M Smith	Unit operation of Chemical Engineering	Tata Mc Grawhill
2	Treybel	Mass Transfer	Tata Mc Grawhill
3	K Gavane	Unit operations II	Nirali Publication
4.	Binay Dutt	Separation Operation	PHI Publication

Th. 4 CHEMICAL PROCESS INDUSTRIES – I

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

A. 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.

B. 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.

C. Topic wise distribution of periods		
Sl. No.	Topics	Periods
1	Concept of unit operation & unit process	08
2.	Industrial gases	07
3.	Acids	07
4.	Chloro-alkali industry	07
5.	Pulp & paper industry	06
6.	Cement industry	05
7.	Metallurgical Industries	10
8.	Fertilizers	10
	Total	60

COURSE CONTENTS:

D. CHAPTER – I Concept of Unit operation and process

- 1.1 Concept of unit operation & unit operation
- 1.2 General principles applied in studying an industry, types of flow sheet
- 1.2 Economics in Chemical process, 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 producer gas and water gas
- 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.

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 Manufacture of paper by wet process
- 5.3 Recovery of chemicals from black liquor, by product utilisation
- 5.4 Different type of paper products.
- 5.5 Additives used in paper production and their application.

CHAPTER – VI CEMENT 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

CHAPTER – VII METALLURGICAL INDUSTRIES

- 7.1 Methods of manufacturing cast iron
- 7.2 Properties of cast iron
- 7.3 Manufacture of sponge iron, wrought iron
- 7.4 Different methods of steel manufacturing
- 7.5 Manufacture of alumina from bauxite by Bayer's process
- 7.6 Extraction of aluminum from alumina by Hope's process
- 7.7 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.

Syllabus Coverage up to I.A

Chapter 1,2,3,4

E. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	C Dryden	Chemical Technology	Tata Mc Grawhill
2	N Shreeve	Chemical Process Industries	Tata Mc Grawhill

Pr 1.ORGANIC CHEMISTRY LABORATORY

Common to Chemical, Biotechnology & Food Technology

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	75	Examination	3 hours
Laboratory Periods:	5P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

A. Rational:

Most of the industrial processes involve reaction involving organic compound. In order to acquaint the students to give practical exposure and hands on training of handling chemical reaction in the laboratory, the practical subject is introduced. The understanding of students on organic synthesis will improve after conducting the experiment in laboratory.

C. Objective:

On completion of practical of organic chemistry the student should be able to:

1. Conduct organic synthesis in laboratory with safety measures
2. Can detect the elements present and functional groups in unknown organic compound
3. Can prepare organic compound in laboratory by simple synthesis

Experiment wise distribution of Periods		
Sl. No.	List of Experiments	No. of Periods
1.	Detect the following elements in the organic compound	30
	i) Nitrogen	
	ii) Sulphur	
	iii) Halogen	
2.	Determine different functional groups of	30
	i) Carboxylic group	
	ii) Phenolic group	
	iii) Alcoholic group	
	iv) Aldehyde group	
	v) Ketonic group	
3.	Prepare in Laboratory	15
	(i) Oxalic acid (ii) Benzoic acid (iii) Methyl Orange	

E. Book Recommended

Sr no	Name of Author	Title of Book	Name of Publisher
1	Dr S K Nayak	Practical Chemistry for +2 students	ABC Publication
2	O.P. Pandey, D.N. Bajpai	Practical Chemistry for B.Sc students	S Chand

Pr-2 HEAT TRANSFER LABORATORY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	75	Examination	3 hours
Laboratory Periods:	5P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

A. Rational:

Heat transfer in process industry is an important unit operation. The practices on heat transfer experiments will help the students to understand basic principles of modes of heat transfer and acquaint the students about the construction and operation of various heat transfer equipments.

B. Objective:

On completion of practical of heat transfer the student should be able to:

1. Understand the concept of methods of heat transfer
2. Can handle operation of heat transfer equipment
3. Understand the construction of heat transfer equipment

D.	EXPERIMENT Wise Distribution of Periods	
SL .No.	Experiment	Period
1	Demonstrate operation of single pass shell and tube heat exchanger horizontal and vertical type	10
2	Demonstrate operation of Finned heat exchanger	10
3	Demonstrate operation of multi pass, horizontal heat exchanger	10
4	Demonstrate operation of double pipe heat exchanger	10
5	Demonstrate operation of Stefan's Boltzmann apparatus	10
6	Demonstrate heat transfer in forced convection and natural convention	10
7	Demonstrate operation of Boiler	10
8	Demonstrate heat transfer through composite wall	05
	Total	75

Pr. 3 MASS TRANSFER LABORATORY – I

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	75	Examination	3 hours
Laboratory Periods:	5P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

B. Rational:

Mass transfer is the net movement of mass from one location, usually meaning stream, phase, fraction or component, to another. Mass transfer occurs in many processes, such as absorption, evaporation, drying, precipitation, membrane filtration, and distillation. Mass Transfer is the Basic Subject of Chemical Engineering. A Chemical Engineer should know that how an operation is taking place for example ammonia dissolves in water we know that but how dissolves? Mass Transfer tells us the mechanisms and Concentrations between different phases. All the basic operations in industries is based upon mass transfer. Simple laboratory based mass transfer operation are designed for better understanding of the concept of mass transfer

C. Objective:

On completion of practical of mass transfer the student should be able to:

1. Understand the concept of distillation, absorption and adsorption
2. Can correlate different parameters in mass transfer
3. Understand the construction and operation of mass transfer equipment

EXPERIMENT Wise Distribution of Periods		
SL. No.	Experiment	Period
1	Demonstrate operation of a fractional distillation unit	05
2	Demonstrate operation of the differential distillation equipment and verify the Rayleigh's equation for the given sample	10
3	Identify different components and operate the bubble cap rectification column and Determine plate efficiency and plot Mc-Cabe Thiele diagram	10
4	Demonstrate the operation of a steam distillation unit	10
5	Demonstrate operation of an open boiling pan	10
6	Demonstrate and operation of a packed bed absorption tower	10
7	Determine the absorption isotherm of acetic acid by activated charcoal.	10
8	Study of adsorption of oxalic acid aqueous solution on charcoal and prove the validity of Freundlich's adsorption isotherm and Langmuir's adsorption isotherm	10
	Total	75

Pr. 4 CHEMICAL TECHNOLOGY LABORATORY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4 th
Total Periods	45	Examination	3 hours
Laboratory Periods:	3P/Week	Sessional Marks:	25
Tutorial	-	End Semester Examination Marks	25
Maximum Marks:	50		

A. Rational:

Chemical engineering is a discipline influencing numerous areas of technology. In broad terms, chemical engineers conceive and design processes to produce, transform and transport materials — beginning with experimentation in the laboratory followed by implementation of the technology in full-scale production. Quality control and different analysis are important for all industry.

B. Objective:

On completion of practical of chemical technology-1 the student should be able to:

1. Can prepare small chemical finished product
2. Can do analysis of product for quality control
3. Understand the basic principles of Chemical Technology

C.	EXPERIMENT	Wise Distribution of Periods
SL. No.	Experiment	Period
1	Prepare Soap from vegetable oil	03
2	Estimate free alkali present in soap	03
3	Determine the acid value of an oil	03
4	Determine the saponification value of an oil	03
5	Determine amount of calcium and calcium oxide present in a given sample of cement	06
6	Determine the % of available chlorine in a given sample of bleaching power	03
7	To separate various pigment in extract of spinach leaves by TLC	06
8	Determine the % of nitrogen in a fertilizer sample	06
9	Prepare Urea formaldehyde and phenol formaldehyde resin in the laboratory	06
10	Determine the % of copper in Brass	06
	Total	45

D. Book Recommended

Sr no	Name of Author	Title of Book	Name of Publisher
1	S K Basin & Sudharani	Laboratory manual on Engineering Chemistry	Dhanpat Rai