Ref: UPL University /SRICT/BOS/CH/2021-22/01
Date: 23-03-2022

Proposed Teaching Scheme for Second Year Diploma in Chemical Engineering

Semester-III (Chemical Engineering) Proposed Structure

Sr. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Total Credits	E	M	I	V	Total Marks
				L	T	P							
1	Humanities and Social Sciences including Management courses	MH1201	Communication Skills in English	3	0	2	5	4	70	30	20	30	150
2	Program Core-I	CH1201	Industrial Stoichiometry	2	1	0	3	3	70	30	20	30	150
3	Program Core-II	CH1202	Chemical Engineering Thermodynamics	2	1	0	3	3	70	30	20	30	150
4	Program Core-III	CH1203	Chemical Process Technology-I	2	0	2	4	3	70	30	20	30	150
5	Program Core-IV	CH1204	Mechanical Operations	2	0	4	6	4	70	30	20	30	150
6	Program Core-V	CH1205	Fluid Flow Operations	3	0	4	7	5	70	30	20	30	150
7	Mandatory Course - Audit course	MH1202	Essence of Indian Traditional Knowledge	1	0	0	1	0	0	0	20	30	50
8	Project work, seminar and internship in industry or elsewhere Mandatory Courses	MH1203	In Plant Training	0	0	0	0	1	0	0	50	0	50
	Total						**29**	**23**					**1000**

Semester-IV (Chemical Engineering) Proposed Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Total Credits	E	M	I	V	Total Marks
				L	T	P							
1	Program Core-VI	CH1206	Mass Transfer	2	0	4	6	4	70	30	20	30	150
2	Program Core-VII	CH1207	Chemical Process Technology-II	2	0	4	6	4	70	30	20	30	150
3	Program Core-VIII	CH1208	Process Heat Transfer -I	2	0	4	6	4	70	30	20	30	150
4	Program Core-IX	CH1209	Pollution Control & Effluent Treatment	3	0	0	3	3	70	30	0	0	100
5	Program Elective courses relevant to chosen specialization/branch	CH1210/11	Program Elective-I	3	0	2	5	4	70	30	20	30	150
6	Open subjects – Electives from other technical and /or emerging subjects	CH1212/13	Open Elective-I	3	0	0	3	3	70	30	0	0	100
	Total						29	22					800

A. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
E	Theory External Examination Marks
M	Theory Internal Examination Marks
I	Practical Internal Examination Marks
V	Practical External Examination Marks

B. List of Program and Open Electives

Program Elective -I	Open Elective-I
Renewable Energy	Solid Waste Management
Utilities And Instrumentation in Chemical Plant	Industrial Water Pollution

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering
Subject Code: MH1201
Subject Name: Communication Skills in English

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Language and Communication

Prerequisite: Zeal to learn the Language

Rationale: The rationale of the curriculum is to help students to express their original ideas in English and also develop interest in language and literature with a focus on comprehension, and reading, speaking and writing skills.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No	Content	Total Hrs.
	SECTION-A	
1	**Prose:** 1) An Astrologer's Day by R. K. Narayan 2) The Portrait of a Lady by Khushwant Singh, 3) Sparrows by K.A. Abbas 4)The Night Train at Deoli by Ruskin Bond	**6**
2	**Poetry**:1) My Grandmother by Elizabeth Jennings, 2) My Papa's Waltz by Theodore Roethke, 3) The Road Not Taken by Robert Frost 4) The Tyger by William Blake.	**7**
3	**Fiction:** Robinson Crusoe by Daniel Defoe	**7**
	SECTION-B	
4	Listening Ability: Hearing & Listening, Types of Listening, Traits of an Effective Listener	**6**

Diploma in Engineering
Subject Code: MH1201
Subject Name: Communication Skills in English

5	Speaking Skills: Group Discussion, Interview, Presentation Strategies , Public Speaking	**6**
6	Writing :Mastering the final Skill: Paragraph Writing, Comprehension Passage Business Letters-Complaint, Enquiry, Sales, Order, Apology) Email Etiquettes	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	15	5	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Prism: Spoken and Written Communication, Prose & Poetry' published by Orient Longman
2. Robinson Crusoe, Daniel Defoe, Harper Collins, UK
3. Communication Skills by Sanjay Kumar& Pushp Lata, OUP.
4. The Most Anthologized Poems of the Last 25 Years - Literary ...

List of Practicals /Tutorials:

Language Laboratory Activities:

Sr. No.	Practical/ Exercise	Apprx. Hours required
1	Conversation at a Clinic	**2**
2	Seeking Information about various Engineering Programs at an Institute	**2**
3	At the cinema Hall	**2**

Diploma in Engineering
Subject Code: MH1201
Subject Name: Communication Skills in English

4	Letter Writing	**2**
5	Conversing with your colleagues/Co-workers	**2**
6	Comprehension Passage	**2**
7	Picture Description & Completion of a Story	**2**
8	Presentation.	**2**
9	Group Discussion	**2**
10	Interview	**2**

Course Outcomes:

After Learning this course, students will be able to:

Sr. No.	**CO statement**
CO-1	Use English in day-to-day communication
CO-2	Use various forms of vocabulary in varied situations in oral and written communication.
CO-3	Comprehend the dynamics of various rules of grammar and check its validation while they speak and write language correctly
CO-4	Use grammar effectively to make themselves competent Listener, Speaker, Reader and Writer by exposing to various set of situations
CO-5	Write various formal and informal documents of day to day life
CO-6	Prepare for lifelong learning and enjoyment of English Language and literature.

List of Open Source Software/learning website:

- http://www.free-english-study.com/
- http://www.english-online.org.uk/course.htm

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering
Subject Code: CH1201
Subject Name: Industrial Stoichiometry

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Program Core-I

Prerequisite: Basics Mathematics, Applied Sciences

Rationale:

Chemical engineering is all about transformation of species of material by a chemical process and the subject stoichiometry (chemical process calculations) forms one of the core subjects of the course. It mainly deals with the qualitative and quantitative aspects of material and energy transformations during a chemical process, the knowledge of which is very essential in the design of chemical reactors, equipment's and the chemical process as a whole.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	1	0	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Mathematical Principles:** System of units, Units and dimensions: basic and derived units, Unit processes and operations, Process flow sheet, Block diagram, Steady and unsteady state operations	3
2	**Gases, Gas mixtures & Gas liquid Mixtures:** Ideal gas law, Dalton's law, Amagat's law, Vander Waals equation of state	4

Diploma in Engineering
Subject Code: CH1201
Subject Name: Industrial Stoichiometry

	Avg. molecular wt. of a gas mixture, density of a gas mixture, composition of mixture, Raoult's law, Henry's law, Antoine's equation	
3	**Material Balance for Physical Systems:** Law of conservation of mass. Definition & block diagram of various unit operations such as drying, evaporation, crystallization, extraction, distillation, absorption, filtration, etc. Solving material balance problem in distillation, drying, evaporation operations Solving material balance problem in crystallization, extraction, absorption, filtration, mixing & blending.	**5**
	SECTION-B	
4	**Material Balance for Reacting Systems:** Definition & terms, Stoichiometric equation, stoichiometric co-efficient, stoichiometric ratio. Limiting component, excess component, conversion, yield, selectivity & % excess. Solving material balance problems with chemical reactions for calculating % conversion, % yield, and % excess, of raw materials or products. Introduction to unsteady-state material balance.	**4**
5	**Energy Balance:** Law of conservation of energy, different forms of energy, heat/thermal energy & its units. Sensible heat, latent heat, specific heat, heat capacity, heat capacity at constant volume, and at constant pressure, variation of heat capacity with temp. Equation for calculating the sensible heat requirement using heat capacity data. Standard states for gas, liquid & solid. Heat of formation, heat of combustion, heat of reaction, Hess's law of constant heat summation and its application. Heat of dilution & dissolution. Effect of temperature on heat of reaction, Relationship for calculating the heat of reaction at any temp.	**5**

Diploma in Engineering
Subject Code: CH1201
Subject Name: Industrial Stoichiometry

	Heat effects associated with chemical reactions (endothermic and exothermic). Adiabatic operations, adiabatic reaction & adiabatic reaction temp.	
6	**Fuels and Combustion:** Calorific values, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations. Proximate and ultimate analysis of coal. Solving material balance problems with fuels & combustion reaction for calculating percent excess air.	**3**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	35	35	20	-	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks: NA

Reference Books:

1. Bhatt, B. I., Vora, S. M., "Stoichiometry", Tata McGraw Hill, NewDelhi, 2nd Ed., 2004.
2. Hougen, O. A., Watson, R. M., Ragatz R.A., "Chemical ProcessPrinciples Part I", CBS Publications, 2nd Ed., 1976.
3. Himmelblau, D. M., "Basic Principles and Calculations in Chemical Engineering", Prentice Hall of India, New Delhi, 8th Ed., 2012.
4. Narayanan. K.V., Lakshmikutty. B., "Stoichiometry and Process Calculations", Prentice Hall of India, New Delhi, 2nd Ed., 2009.
5. Venkatramani, V., Ananatharaman, N., Begum, S., "Process Calculations", Prentice Hall of India, 2nd ed., 2011.
6. Felder, R. M., Rousseau, R. W., "Elementary Principles of Chemical Processes", John Wiley and Sons, 3rd Ed., 2005.

List of Practical/Tutorials: NA

Course Outcomes:

Diploma in Engineering
Subject Code: CH1201
Subject Name: Industrial Stoichiometry

Students should be able to

Sr. No.	CO statement
CO-1	Identify the various units and conversion
CO-2	Differentiate the behavior of gases, mixtures and solutions
CO-3	Analyze the material balance on physical systems
CO-4	Analyze the material balance on reacting systems
CO-5	Describe the energy balance in reacting and non-reacting systems with phase change.
CO-6	Evaluate the calorific values of fuel

Diploma in Engineering
Subject Code: CH1202
Subject Name: Chemical Engineering Thermodynamics

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Program core - II

Prerequisite: Basics of Physics and Mathematics.

Rationale: Knowledge of thermodynamics from a chemical engineering viewpoint is essential to study principles and applications of laws of thermodynamics to real systems. This subject is also useful to calculate thermodynamic properties of any chemical species and their mixtures.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	1	0	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction and Basic concept:** The scope & Limitations of thermodynamics, System, functions, properties and surroundings, System-Homogeneous and heterogeneous, Closed and open, State of System, Properties -Extensive and intensive, Function -State and Path function, Process-Reversible and irreversible process, Force, Pressure, Work and Energy, Steady state, Equilibrium state and Phase rule, Equilibrium state and Phase rule, Temperature & Zeroth law of Thermodynamics, Ideal gas temperature scale, Simple examples (numerical) on Force, Pressure, Work and Energy physical quantities, phase rule and laws of thermodynamics.	6
2	**First Law of Thermodynamics** First law of thermodynamics, Internal energy concept, Enthalpy and Heat capacity, First law for non-flow processes and flow processes of chemical engineering, Simple numerical on first law and energy - Internal Energy, Enthalpy and Heat capacity.	3
3	**Volumetric properties of pure fluids:** PVT behaviour of pure fluids, Ideal gas and equation of state, Ideal gas Process: Constant Volume	4

	process, Constant Pressure process, Constant Temperature process, Adiabatic Process, Polytropic Process, Equation of state for real gases, Vander Waals Equation, Virial Equation, Compressibility charts, Simple examples (numerical).	
	SECTION-B	
4	**Heat Effects** Sensible heat, Latent heats of pure substances, Standard heat of reaction, Standard heat of formation, Standard heat of combustion, Hess's Law of constant heat summation, Effects of temperature on heat of reaction Temperature of reaction, Simple numerical.	**3**
5	**Second law of thermodynamics:** Limitations of 1st law of thermodynamics, General Statements of second law of thermodynamics, Concept of entropy, Heat reservoir, Heat engine and Heat pump, Carnot cycle and thermodynamic temperature scale, Calculation of entropy changes during: Phase change, Ideal gas processes, Adiabatic mixing, Isothermal mixing, and Chemical reaction, Entropy changes of an Ideal Gas, Clausius Inequality, Mathematical statement of Second law, Entropy and Irreversibility, Simple numerical.	**6**
6	**Application of laws of thermodynamics:** Thermodynamics of flow Process: Fundamental equations and relationships, flow in pipes, Problems on Application of first law of thermodynamics to steady state flow process.	**2**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	25	15	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Smith, J. M., Vanness, H. C., Abbott, M. M., Swihart, M. T., "Introduction to Chemical Engineering Thermodynamics", McGraw-Hill Companies, Inc. 8th Ed., 2018.
2. Kyle, B. G., "Chemical and Process Thermodynamics", Prentice-Hall Inc. 1992.

3. Rao, Y.V.C., "Introduction to Thermodynamics", Wiley Eastern Limited, 2nd Ed., 2004.

Reference Books:

1. Sandler, S. I., "Chemical, Biochemical and Engineering Thermodynamics", John Wiley and Sons Ltd, International Edition, 4th Ed., 2007.
2. Narayanan, K. V., "A textbook of Chemical Engineering Thermodynamics", Prentice-Hall of India Pvt. Ltd., 2nd Ed., 2013.

List of Practical/Tutorials:

1. Problems on Basic concepts of thermodynamics.
2. Identify and list real situations which works on: Zeroth law.
3. Real life examples, demonstration of real systems on first law of thermodynamics.
4. Energy equation & its application to: Non flow process, Open system. Steady flow (Steady flow energy equation –SFEE).
5. Collecting Movies/Animations and problem solving based on PVT behaviour of fluids.
6. Appreciate importance of entropy and Discuss on Second law of thermodynamics, Identify and list real situations which works on: Second law of thermodynamics.
7. Prepare chart for different thermodynamics process with the help of P-V and T-S diagram.
8. Discussion on Hess's Law of constant heat summation and examples.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Develop fundamental understanding of the basic principles of thermodynamics and related calculations.
CO-2	Demonstrate the use and applications of the first law of thermodynamics
CO-3	Evaluate changes in different thermodynamic properties for pure fluids using equations of state (EOS).
CO-4	Understand the heat effects of chemical reactions & learn to calculate heat of reaction and temperature of reaction.

CO-5	Understand the concept of entropy, demonstrate the use and applications of the second law of thermodynamics.
CO-6	Apply thermodynamic principles to the analysis of flow in pipes & evaluate laws of thermodynamics to steady state flow process.

List of Open-Source Software/learning website:

1. Students can refer to video lectures available on the websites including NPTEL.
2. Students can refer to the CDs which are available with some reference books for the solution of problems using softwares.
3. Students can develop their own programs for the solutions of problems.
4. XSEOS–an Open Software for Chemical Engineering Thermodynamics

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering

Subject Code: CH1203

Subject Name: Chemical Process Technology-I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Program Core-III

Prerequisite: Basic Organic and Inorganic Chemistry

Rationale: Chemical Unit Processes is essential for chemical engineering as it gives an overview of all chemical process industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction and Mechanisms of Unit Processes:** Scope of chemical Industry, Classification of Chemical Industries, Alkylation and Acylation, e.g. alkylation of benzene, phenols, etc. Halogenation, e.g. chlorination of toluene, Nitration and Sulfonation, e.g. nitration, sulfonation of benzene, etc. Hydrogenation and Reductive Alkylations.	**4**
2	**Acids:** Physical and chemical properties of sulphuric acid, Uses of sulphuric acid, Manufacture of sulfuric acid by DCDA process, Major engineering problems for sulfuric acids, Uses and physical properties of HCL, Manufacture of hydrochloric acid by synthetic method	**4**
3	**Phosphorus and Phosphoric Acid :** Physical properties of phosphors, Manufacturing of phosphorus by electrical furnace process, Physical properties and uses of phosphoric acid. Types of manufacturing processes, Manufacturing method of phosphoric acid by HCL leaching, Major engineering problems for manufacturing phosphoric acid.	**4**
	SECTION-B	
4	**Chlor-Alkali Industries:**	**4**

	Different process of production of soda ash, Manufacturing of soda ash by Solvay process, Physical properties of soda ash, caustic soda and chlorine, Production of caustic soda by electrolytic process, Major engineering problems for manufacturing soda ash, caustic soda and chlorine	
5	**Cement and Lime:** Introduction and properties of cement, Types of cement, Manufacturing process of Portland cement, Major Engineering problems of cement industries, Physical properties of lime, Uses of lime, Manufacturing process of lime by hydrated lime process.	**4**
6	**Polymer:** Introduction, classification of polymers, Modes of polymerization, Manufacturing process of vinyl chloride from ethylene di-chloride, Difference between thermosetting and thermoplastic.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	15	20	05	05	05

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Dryden, C. E., "Outlines of Chemical Technology", East West Press. Pvt. Ltd., New Delhi, 3rd Ed.,1997.
2. Austin, G. T., "Shreve's Chemical Process Industries", McGraw Hill, 5th Ed., 1984.

Reference Books:

1. Sharma, B. K., "Industrial Chemistry", Krishna Publishing House, 2016
2. Kent, J. A., "Riegel's Handbook of Industrial Chemistry", Springer Publication, 1992.

List of Practical:

1. Standardization of sulfuric acid solution.
2. Standardization of HCL acid solution.
3. Standardization of NaOH solution.
4. Standardization of KOH solution.

5. Estimation of CaOH group.
6. Preparation of Hydrated lime.
7. Preparation of soap.
8. Preparation of detergent.
9. To prepare caustic soda by chemical method.
10. Synthesis of polymer.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Develop fundamental understanding of the process carried out in chemical industry.
CO-2	Explain the basic reaction steps involved in the production of various grades of products.
CO-3	Explain the basic reaction steps involved in the production of various grade of sulfuric acid, nitrogen and its derivative products and phosphorous industries.
CO-4	Predict all possible trouble shootings arise in chemical plants.
CO-5	To review the practical importance and relevance of process takes place in chemical industry.
CO-6	Resolve all technological and economic problems arise in the chemical manufacturing plants.

List of Open-Source Software/learning website:

NPTEL, World Wide Web, etc.

Diploma in Engineering

Subject Code: CH1204

Subject Name: Mechanical Operations

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Program Core-IV

Prerequisite:

Chemical engineering consists of several unit operations and unit processes. Thus, unit operations are a very essential part of chemical engineering; and hence, basic knowledge about the principles and equipment of solid-solid unit operations and solid-liquid unit operations is mandatory for any professional chemical engineer.

Rationale:

The main objective of this subject is to study the basic mechanical operation (crushing, grinding, filtration, etc.) takes place during the process in chemical industry. This subject provides the fundamental knowledge regarding to particle size reduction, conveying and also deals with the construction & working of equipment's used for mechanical operations.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	4	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Solid Particle:** Shape and size of particle, Sphericity, Mixed Particle Size, Average Particle Size, Particle size measurement technique.	3
2	**Size Reduction:** Crushing Laws: Ratzinger's, Bond's and Kick's, Principle, method, (crushing, grinding), Open and closed circuit, Jaw Crusher, Roll Crusher, hammer mill, Ball Mill critical speed of ball mill.	4
3	**Flow Of Fluid Past Immersed Bodies:** Mechanics of particle motion, Equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, Terminal velocity, Drag coefficient, Criterion for settling regime, Hindered settling, Centrifugal separators. Fluidization: Introduction, condition for fluidization.	4

Diploma in Engineering
Subject Code: CH1204
Subject Name: Mechanical Operations

	SECTION-B	
4	**Solid-Liquid Separation:** Sedimentation: Concept, free and hindered settling, Stokes law (terminal settling velocity), factors affecting the rate of sedimentation. Sedimentation Equipment: thickener, clarifier and settling tank: Principle, construction (different zones) and its working, Filtration: Principle, types, factors affecting filtration rate, use of filter aid (example of filter aid), Plate and frame filter press, rotary vacuum drum filter.	**5**
5	**Mixing and Agitation:** Principle of mixing (solid-solid, solid-liquid, Liquid-Liquid), mixing index, Sigma Mixer, Ribbon blender: Principle, construction, working, Flow patterns (radial and axial flow pattern), Concept of vortexing.	**4**
6	**Sampling, Storage and Conveying Of Solids:** Sampling of solids, Storage of solids, Open and closed storage, Bulk and bin storage, Conveyors-Belt conveyers, Chain conveyor, Apron conveyor.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	15	15	10	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Patil, K. D., "Mechanical Operations Fundamental Principles and Applications", Nirali Prakashan, 2016.
2. Gavhane, K.A., "Unit Operation-1 (Fluid Flow and Mechanical Operations)", Nirali Prakashan, 2016.

Reference Books:

1. McCabe, W. L., Smith, J. C., Harriott, P., "Unit Operation in Chemical Engineering", 7th Ed., McGraw Hill, 2014.

List of Practical:

1. To determine the screen efficiency for the given sample by sieve analysis.
2. To determine the screen efficiency for the given sample by vibrating screen.

3. To determine nip angle, Reduction Ratio, Ribbon Factor, Rittinger's constant, Bond's constant, Kick's constant, Work Index as well as Theoretical & Actual Capacity using roll crusher.
4. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using jaw Crusher.
5. To calculate the overall efficiency of the cyclone separator.
6. To carry out the batch sedimentation tests.
7. To carry out gravity filtration test.
8. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index for ball mill.
9. To study filter press.
10. To study size reduction of material by drop weight crusher.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	To characterize particles and study the size analysis of particles to meet the need of chemical industries.
CO-2	Describe the size reduction equipments for solid-solid operations.
CO-3	To understand the flow of particles through fluids.
CO-4	To evaluate the parameters of sedimentation and filtration.
CO-5	To identify the different types of mixing equipments
CO-6	To elaborate the concept of conveying of solids.

List of Open-Source Software/learning website: Reference to NPTEL lectures can be made for a better understanding regarding mechanical operation done in industries under different conditions.

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering

Subject Code: CH1205

Subject Name: Fluid Flow Operations

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Program Core - V

Prerequisite: Basic Concepts of Engineering Mathematics and Physics.

Rationale: Chemical Engineers are converting raw material into valuable product. Process stream moves through different unit operations and pipe network. Fluid flow operations plays an important role in chemical plants.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	4	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Properties of Fluid:** Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity, Newton's law of viscosity and its applications. **Fluid Statics:** Pascal's Law and Hydrostatic equation, absolute and gauge pressures - pressure measurements by manometers, Hydrostatic equilibrium, decanters like continuous gravity, centrifugal etc.	**6**
2	**Fluid Flow Phenomena:** Velocity fluid, Velocity gradient and rate of shear, Newtonian and Non Newtonian fluids, Reynolds number and its significance, laminar and turbulent flow.	**6**
3	**Basic equations of Fluid Flow:** Mass velocity; average velocity; potential flow; streamlines, stream tubes, macroscopic momentum balance, Equation of continuity, Bernoulli's equation.	**6**
	SECTION-B	
4	**Flow Through Pipes:** Critical Reynolds number, velocity distribution in pipes, friction factor, Laminar flow through pipe, Hagen-Poiseulli's equation, Turbulent flow through pipe, Minor head losses in pipes.	**6**

5	**Measurement of flowing fluids:** Full bore meter like venturimeter, orifice meter, coefficient of discharge of venturimeter, orifice meter, area meters like Rotameter, target meters, Notches etc., insertion meters like pitot tubes etc. valves like Gate, Globe, Plug cocks, Ball, Check valves.	**6**
6	**Pumps:** definition and classifications - Centrifugal pump: classifications, working principles, , specific speed, Reciprocating pump: classification, working principles, cavitation in pumps, rotary pumps: working principles of gear and vane pumps	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	30	10	5	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. McCabe, W., Smith, J. C., Harriott P., "Unit Operations of Chemical Engineering", McGraw Hill International, 7th Ed., 2005.

Reference Books:

1. Munson, B. R., Young, D. F., Okiishi T. H., "Fundamentals of Fluid Mechanics", John Wiley & Sons, 8th Ed., 2018.
2. Gupta, S., Gupta, V., "Fluid Mechanics and its applications", New Age International Publishers, 3rd Ed., 2013.
3. Richardson, J., Coulson, J., Harker, J., Backhurst, J. R. "Chemical Engineering, Volume I, – Fluid flow, Heat Transfer and Mass Transfer", Butterworth – Heinemann Publication, 6th Ed., 2017.

List of Practical:

1. To study and verify Bernoulli's Theorem.
2. To calibrate an Orifice meter and obtain its coefficient of discharge.

3. To study Reynolds's Experiment Apparatus.
4. Reciprocating Pump testing and characteristic curves
5. Friction vs. Re losses in Pipe Friction using water.
6. Study of Pressure measurement devices.
7. To Study Notched Weirs Apparatus and obtain its discharge coefficient.
8. To calibrate the given Rota meter.
9. Calibration of Triangular Notch and find the value of discharge co-efficient.
10. Study of Pressure Drop in packed bed.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	State the Newton's law of viscosity and explain the mechanics of fluids at rest and in motion.
CO-2	Discuss velocity gradient, rate of shear, Newtonian and Non-Newtonian fluids, and Reynolds number.
CO-3	Derive Bernoulli's equation.
CO-4	Evaluate pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.
CO-5	Discuss flow meters and valves.
CO-6	Classify the various types of pumps and their working principles.

List of Open-Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding.

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering

Subject Code: MH1202

Subject Name: Essence of Indian Traditional Knowledge

Shroff S.R. Rotary Institute of Chemical Technology

Semester: III

Type of course: Audit Course

Prerequisite: Zeal to learn the subject.

Rationale: At the end of the course, students will become aware of certain knowledge traditions and practices of India that are being followed in their families and society around them.

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks				Total Marks
L	T	P	C	Theory Marks				
				ESE (E)	PA (M)	ESE (V)	PA (I)	
1	-	-	0	-	-	30	20	50

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to Traditional Knowledge:** Definition of traditional knowledge, scope and importance, kinds of traditional knowledge, traditional knowledge Vs western knowledge.	03
2	**Protection of Traditional Knowledge:** Significance of protection of traditional knowledge,	02
3	**Role of Government:** Role of Government to harness traditional knowledge.	02
	SECTION-B	
4	**Education System in India**: Education in ancient, medieval and modern India, Aims of education, Different subjects of traditional education in India.	03
5	**Civilization and Culture:** Culture and Civilization, Cultural Heritage.	02

Diploma in Engineering
Subject Code: MH1202
Subject Name: Essence of Indian Traditional Knowledge

6	**Essence of Indian Culture:** Essence of Indian Traditional Culture.	**01**

Suggested Specification table with Marks (Practical):

Distribution of Practical Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**10**	**5**	**5**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino.

Course Outcomes: After completing the course, students will be able to

Sr. No.	**CO statement**
CO-1	Understanding the concept of traditional knowledge and its importance
CO-2	Analyzing the need and importance of protecting traditional knowledge
CO-3	Understanding the traditional educational system in India
CO-4	Analyzing the Indian civilization and culture
CO-5	Understanding the basics and essence of traditional and western knowledge
CO-6	Analyzing the cultural heritage of traditional and modern India

List of Open Source Software/learning website:

- https://en.wikipedia.org/wiki/Traditional_knowledge
- https://oufastupdates.com/essence-of-indian-traditional-knowledgeeitk/

Diploma in Engineering

Subject Code: CH1206

Subject Name: Mass Transfer

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Program Core – VI

Prerequisite: The knowledge of concentration and its different forms is known from Chemistry course.

Rationale: The operations which involve changes in composition of solutions, are known as the mass transfer operations. Mass transfer operations are required for preliminary purification of raw materials or final separation of products from by-products. Mass transfer operations are major and important activity in most of the chemical plants. Hence the course has been designed to develop the following competency and its associated cognitive, practical and affective domain learning outcomes.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	4	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Fundamental of Mass Transfer:** Introduction of Mass transfer operations, Operations based on direct contact of two immiscible phases, Direct and indirect operations, Rate of diffusion in Fluids, Molar flux, diffusivity and concentration gradient in Fluids, Effect of concentration, Temperature and pressure on diffusivity.	4
2	**Gas Absorption:** Industrial application of Absorption, effect of temperature and pressure, Ideal solution and Raoult's law, Solvent for absorption, Classification of equipment for Gas-Liquid operations: Gas dispersed, Mechanically Agitated Vessel, Tray tower.	4
3	**Extraction:** Equilibrium for three component system, Equilateral triangular co-ordinates system, Effect of temperature and pressure on	4

	solubility, Criteria for choice of solvent, different stages of extraction, Equipment: agitated vessel, flow mixer and settler, spray tower, packed tower and centrifugal extractor.	
SECTION-B		
4	**Distillation:** Vapor Liquid Equilibria, Constant pressure equilibria, Constant temperature equilibria, Relative volatility, Raoult's law, Henry's law, and their uses, azeotropes, introduction of different types of distillations: Flash, steam, vacuum, simple and continuous.	**4**
5	**Humidification:** Vapor-pressure curve, Saturated and unsaturated vapor-gas mixtures, Concept of Absolute humidity, Relative saturation, Percentage saturation, Dew point, Dry bulb temperature, Wet bulb temperature, Adiabatic saturation temperature.	**4**
6	**Drying:** Drying equilibrium, Definitions and calculation of Moisture content, Equilibrium and free moisture, Bound and unbound moisture, Tray drier, Vacuum drier, Rotary drier, Spray drier, Fluidized bed drier.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	35	10	10	5	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Treybal, R. E., "Mass Transfer Operations", McGraw Hill 3rd Ed., International Edition, 1981.

Reference Books:

1. Warren, L., Smith, J. C., "Unit Operation of Chemical Engineering", 7th Ed., McGraw Hill Publication, New York, 2004.
2. Gavhane, K. A., "Unit Operations-II", Nirali Prakashan, Pune, 2006.
3. Chattopadhyay, P., "Unit Operations of Chemical Engineering-Volume -I", Khanna Publishers, New Delhi, 1995.

Diploma in Engineering

Subject Code: CH1206

Subject Name: Mass Transfer

List of Practical:

1. Demonstrate principle, construction and working of equipments for gas–liquid operations with models.
2. Carry out simple distillation in glass assembly.
3. Find out equilibrium moisture content and drying time of wet solid.
4. Characterize industrial adsorbents and observe their samples.
5. Determine diffusivity of gas-liquid system at room temperature.
6. Measure recovery of salt using sand-salt mixture in single stage leaching.
7. Measure recovery of salt using sand-salt mixture in two stage leaching.
8. Obtain tie-line data for Acetic Acid, Benzene and water.
9. Study of leaching equipment.
10. Study of gas-liquid equipment.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Define fundamentals of mass transfer operation.
CO-2	Explain various equipment used in gas-liquid operations.
CO-3	Calculate material balance for extraction process.
CO-4	Compare different distillation operations and choose the appropriate distillation system.
CO-5	Calculate different properties of humidification.
CO-6	Relate heat and mass transfer in drying process.

List of Open-Source Software/learning website:

1) www.unitoperation.com
2) www.nptel.com

Diploma in Engineering
Subject Code: CH1207
Subject Name: Chemical Process Technology-II

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Program Core-VII

Prerequisite: Basic Organic and Inorganic Chemistry

Rationale: Chemical Unit Processes is essential for chemical engineering as it gives an overview of all chemical process industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	4	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Natural Product Industries:** Definition of oil and fat, Physical properties of oil, Methods of extraction of vegetable oil by mechanical and solvent extraction, Hydrogenation of oil, Manufacturing of glycerin by from fat, Define soap and detergent, Method of soap production by continuous hydrolysis and saponification.	5
2	**Carbohydrate Industries:** Introduction, Manufacture of sugar from sugar-cane, Manufacture of starch from maize, Manufacture of dextrin from starch, Major engineering problems in manufacturing of sugar	3
3	**Introduction To Pulp and Paper Industries:** Pulp manufacturing by Kraft process, Difference between sulphate & sulphite process, Manufacturing of Paper. Major engineering problems of paper industries.	4
	SECTION-B	
4	**Fuel and Industrial Gases:** Introduction, Classification of fuel, Method of production of fuel gases (I) producer gas (II) water gas	3

Diploma in Engineering
Subject Code: CH1207
Subject Name: Chemical Process Technology-II

	(III) coke oven gas (IV) natural gas Major engineering problems in manufacturing of coke oven gas, Explanation of Industrial gases	
5	**Fermentation Industries:** Introduction, Types of fermentation processes, Production of ethyl alcohol by fermentation, Manufacturing of lactic acid from corn sugar, Manufacturing of citric acid from molasses, Manufacturing of vinagar from frings method.	**4**
6	**Dye & its Intermediates, Paints and Pigment Industries:** Classification of Dyes according to its Constitution and Application, Introduction to Disperse, Reactive, Azo, Anthraquinone& Vat dyes. Introduction to Paints classification & its constituents, PVC of Paints, Different types of pigments such as white, blue, red, yellow, green, brown.	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	20	30	05	05	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Dryden, C. E., "Outlines of Chemical Technology", East West Press. Pvt. Ltd., New Delhi, 3rd Ed.,1997.
2. Austin, G. T., "Shreve's Chemical Process Industries", McGraw Hill, 5th Ed., 1984.

Reference Books:

1. Sharma, B. K., "Industrial Chemistry", Krishna Publishing House, 2016
2. Kent, J. A., "Riegel's Handbook of Industrial Chemistry", Springer Publication, 1992.

Diploma in Engineering
Subject Code: CH1207
Subject Name: Chemical Process Technology-II

List of Practical:

1. Preparation of apple jam.
2. Preparation of jelly.
3. Preparation of Ice-cream.
4. Preparation of fruit juice.
5. Estimation of Acid value of oil.
6. Estimation of Iodine value of oil.
7. Preparation of citric acid from fruit.
8. Preparation of glycerine from by from soap and fatty acid.
9. To prepare mordant yellow dye.
10. Preparation of fast green o dye.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Define basic processes of manufacturing of soap, detergent and its allied industries.
CO-2	Construct process flow diagrams for different chemical process.
CO-3	Assess the practical importance with the relevance of process taking place in chemical industry.
CO-4	Understand basics of industrial gases.
CO-5	Identify and solve engineering problems in fermentation industries.
CO-6	Describe the manufacturing processes of various inorganic and organic chemicals used in dye industry.

List of Open-Source Software/learning website:

NPTEL, World Wide Web, etc.

Diploma in Engineering
Subject Code: CH1208
Subject Name: Process Heat Transfer- I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Program Core-VIII

Prerequisite: Basic knowledge of mathematics. Fundamentals of material & Energy balance and fluid flow operations.

Rationale: The main objective of this subject is to study the basics of heat transfer takes place in the Chemical industries. This subject provides knowledge regarding the basic modes and aspects of heat transfer process as well as it also provides an idea about various equipment used for heat transfer.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	4	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Modes of Heat Transfer, Heat transfer equipment, Systems of measurement, Units and dimensions.	2
2	**Steady State Conduction:** Fourier's law, Thermal conductivity, Steady state conduction of heat through a composite solid, Steady state heat conduction through a Variable area, Thermal Insulation, Optimum thickness, Critical radius of insulation.	7
3	**Unsteady State Conduction:** Lumped heat capacity analysis, Biot and Fourier's number significance.	2
	SECTION-B	
4	**Heat Transfer Coefficient:** Classification of convection, Concept of heat transfer coefficient, Overall heat transfer coefficient, Fouling factor, resistance in overall heat transfer coefficients, Flow arrangement in heat exchangers, LMTD, Boundary layers theory.	5

5	**Convection:** Heat transfer correlations for free convection from different shapes like flat surface, cylinder, Sphere. Correlations for the heat transfer coefficient: Internal flows and External flows, Momentum and heat transfer analogies.	**5**
6	**Radiation:** Basic laws like Planck's, Wein displacement, Stefen-Boltzmann, Kirchhoff's law. Grey body, Transmissivity, Absorptivity, Reflectivity, Emissivity of black bodies and grey bodies. Application of thermal radiation: Radiation Transfer between surfaces. Radiation through semi-transparent materials.	**3**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	25	10	20	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Dutta, B. K., "Heat Transfer-Principles & Applications", PHI Learning Pvt. Ltd., 1st Ed., 2006.
2. Kern, D. Q., "Process Heat Transfer", McGraw Hill, 1950.

Reference Books:

1. McCabe, W.L, Smith, J.C., Harriott, P., "Unit Operations of Chemical Engineering", 7th Ed., McGraw-Hill Book Co, 2005.
2. Holman, J. P., "Heat Transfer", McGraw-Hill, 10th Ed., 2010.

Diploma in Engineering
Subject Code: CH1208
Subject Name: Process Heat Transfer- I

List of Practical:

Sr. No.	Experiment name
1	To determine the Overall Thermal Conductivity of Composite Wall.
2	To determine the Thermal Conductivity of metal rod.
3	To study the heat transfer from a pin fin under forced and natural convection and calculate the heat transfer co-efficient and effectiveness of the fin.
4	To compare overall heat transfer coefficient for Parallel and Counter flow in a Double Pipe Heat Exchanger and also compare practical overall heat transfer coefficient value with the theoretical value.
5	To analyze the performance of an existing Shell & Tube Heat Exchanger and also calculate the Overall Heat Transfer Coefficient for Shell & Tube Heat Exchanger.
6	(i) To analyze the performance of an existing plate type Heat Exchanger (ii) To calculate Overall Heat Transfer Coefficient & effectiveness for plate type Heat Exchanger.(iii) To analyze effects of changing the flow rate for hot water & cold water fluids.
7	To determine the Overall heat transfer Coefficient (U) for Bare pipe, Longitudinal fins and Transverse fins and to study the operation of heat exchanger.
8	Study of radiation heat transfer by black plate and test plate & calculate the emissivity of test plate.
9	To study the radiation heat transfer by black body and to study the effect of hemisphere temperature on it & calculate the stefan boltzmann constant.
10	To study the performance of heat exchangers in simulator. (Chemcad)

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Identify the different modes of heat transfer.
CO-2	Determine the rate of heat transfer by conduction.
CO-3	Apply the concept of convection to operate heat exchangers.
CO-4	Determine the amount of heat transfer by radiation.
CO-5	Choose proper heat transfer equipment for various applications.
CO-6	Calculate heat transfer rate associated with exchangers.

List of Open-Source Software/learning website:
NPTEL videos/ MIT videos

Diploma in Engineering

Subject Code: CH1209

Subject Name: Pollution Control & Effluent Treatment

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Program Core - IX

Prerequisite: Basic Concepts of Chemistry.

Rationale: Study of environmental pollution, related to the chemical industry is must to understand various types of pollutions and its preventive and control majors. The study of this course would help engineers in operating diverse pollution control equipments for controlling gaseous, water and land pollution.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Basics of Environmental Pollution**: Introduction of pollution and pollutants, Sources of air, water, noise, radioactive and land pollution, Effects of air, water, noise, radioactive and land pollution.	6
2	**Air Pollution:** Ambient air sampling, Sampling of gaseous air pollutants and particulate pollutants, Gravity Settling Chamber, Cyclone separator, Fabric Filter, Wet Scrubber and Electrostatic Precipitator, Thermal incineration.	6
3	**Methods for Control**: Sulfur dioxide emission, Extraction of sulfur from fuels, Hydrodesulphurization of coal, Desulphurization of fuel oils, Desulphurization of flue gases by Dry processes, and wet processes.	6
	SECTION-B	
4	**Water Pollution:** characteristics of water, Water sampling methods, Waste water treatment methods.	8
5	**Solid Waste Management:** solid waste, Methods of solid waste disposal.	6

6	**Environmental Audit and ISO 14001:** Environmental audit, ISO 14001.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	35	25	10	-	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Rao, C. S., "Environmental Pollution control", New age international Pvt. Limited, 1st Ed., 2018.

Reference Books:

1. Mahajan, S. P., "Pollution Control in Process Industries", Tata Mc GrawHill, New Delhi, 2nd Ed., 2008.
2. Bhatia, H. S., "Textb o o k of Environmental Pollution and Control", Galgotia Publication, New Delhi, 1st Ed., 2003.
3. Pandey, G. N., Carney, G. C., "Environmental Engineering", Tata Mc GrawHill, New Delhi, 2003.

List of Practical/Tutorials: NA

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Memorize standards of Environmental Pollution.
CO-2	Interpret the physical and chemical processes used in treatment.
CO-3	Compare the dry and wet process for control of Sulfur emission.
CO-4	Illustrate the advantages and disadvantages of biological process.
CO-5	Summarize wastewater and Solid waste treatment methods.
CO-6	Recollect International Organization for Standardization 14001.

List of Open-Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding.

(Established under Gujarat Private Universities Act, 2009)

Diploma in Engineering
Subject Code: CH1210
Subject Name: Renewable Energy

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Open Elective -I

Prerequisite: Basic knowledge of forms of energy.

Rationale: Energy is the major source for the economic growth of any nation. Standard of living of a country can be directly judged by energy security and per capita consumption of energy. In light of energy crises and environmental concerns, renewable energy is the only solution to save our planet. Hence this subject guide students in dimensions of the renewable sources of energy.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to Renewable Energy:** Classification of Energy Sources, Energy resources (Conventional and nonconventional), primary and secondary energy resources, Advantages and limitations, Energy needs of India and consumption, and energy consumption patterns, and energy conservation and its importance	**6**
2	**Solar Energy:** Solar radiation geometry, solar energy conversion into heat, types of solar collectors, Solar Pond and application of solar energy	**6**
3	**Wind Energy:** Principles of Wind energy conversion, Forces on the Blades (No derivations), Site Selection considerations, Basic components of a wind	**6**

Diploma in Engineering
Subject Code: CH1210
Subject Name: Renewable Energy

	energy conversion system (WECS), Advantages & Limitations of WECS, Wind turbines	
SECTION-B		
4	**Energy From Biomass:** biomass conversion technologies, biogas generation, factors affecting biogas generation, classification of biogas plants & their comparisons, types of biogas plants, community plants & site selection, properties & utilization of biogas, thermal gasification of biomass, pyrolysis, alternative liquid fuels	**6**
5	**Fuel Cell:** Hydrogen – oxygen fuel cell, ion exchange membrane cell, fossil fuel cell, molten carbonate cell, advantages & disadvantages, conversion efficiency, polarization, type of electrodes, applications of fuel cells	**6**
6	**Geothermal and Tidal Energy:** Introduction to geothermal resources, energy conservation & comparison with other resources, applications of geothermal energy. Energy from tides, components of tidal power plants, methods of utilization of tidal energy,	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	40	15	05	00	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Rai, G.D., "Nonconventional energy sources", Khanna Publication, 2001.

Reference Books:

1. Mital, K. M., "Biogas Systems, Principle and Applications", New Age International Ltd., 1996.
2. Rao, S.S., Parulekar, B. B., "Energy Technology: Non-Conventional, Renewable and Conventional", Khanna Publishers, 3rd Ed., 1999.
3. Ravindranath, N.H., Hall, D. O., "Biomass, Energy and Environment, A developing country perspective from India", Oxford University Press, 1995.

4. Sukhatme, K., Sukhatme S. P., "Solar Energy: Principles of Thermal Collections and Storage", Tata McGraw Hill, New Delhi, 2nd Ed., 1996.

List of Practical/Tutorials: NA

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Identify sources of energy along with its merits and demerits.
CO-2	State the importance and potential of solar energy.
CO-3	Explain the concept of wind energy along with the classification of various WECS.
CO-4	Describe the geothermal and biomass energy resources.
CO-5	Explain concept of energy generation from fuel cells and tides.
CO-6	Differentiate the types of renewable energy.

List of Open-Source Software/learning website: www.mnre.gov.in/

Diploma in Engineering

Subject Code: CH1211

Subject Name: Utilities and Instrumentation

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Program Elective-I

Prerequisite: Basic Heat Transfer, Mass Transfer, and Fluid Flow Operations

Rationale: Utilities are essential for manufacturing different chemical products. Use of measuring devices for the measurement of parameters like temperature, pressure, flow, level, viscosity, specific gravity, humidity are necessary for controlling chemical plant for producing materials of desired quality and to maintain plant safety.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Water:** Sources of water, Types of Water, Hard & Soft water, Boiler Feed water and demineralized water, Purification of water, Methods of water softening processes	6
2	**Steam, Air & Inert Gases:** Use of Steam, Air & Inert Gases as utilities, Properties of steam, Steam Generator, Utility air, Types of Air compressor, Inert gas - Nitrogen, Argon	6
3	**Refrigeration:** Concept of refrigeration, Methods of Refrigeration, Types of Primary Refrigerants.	6
	SECTION-B	
4	**Basics of Instrumentation:** Importance of instrumentation in chemical plant, Classification of instruments, Basic elements of instruments, Static and Dynamic Characteristics of instruments.	6
5	**Measuring Devices:** Different Temperature scale, Definition of thermometer, Radiation and optical Pyrometers, Industrial thermocouple:	6

	their principle, construction, working range, lead wires, Pressure gauges, Target meter, Vortex Shredding meter.	
6	**Control Valves, Control Loops & Control System:** Function of relays and interlocks, Control loops, Process control modes : P , PI , PID, ON-OFF	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	35	25	10	-	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

List of Practical:

1. Response of first order system: thermometer.
2. Study Cooling tower operations.
3. Study of Compressors.
4. Reponses of second order system: U-tube manometer or damped vibrator.
5. Calibration of thermos couple test rig.
6. Temperature and pressure measuring devices.
7. Level measuring devices (Bubble system).
8. Viscosity and pH measuring devices (pH Control trainer).
9. Transmitters and transducers.
10. Study of Boilers.

Textbooks:

1. Dhone, D. B., "Plant utilities", Nirali Prakashan, Pune, 2nd Ed., 2012.
2. Donald P. E., "Industrial instrumentation", John-Willey and Sons, New York, 2004.

Reference Books:

1. Coughnour, D. R., "Process System Analysis & Control", McGraw Hill Publication, Newyork, 2nd Ed., 1991.
2. McCabe, Warren L., Smith, J. C., "Unit operation of chemical Engineering", McGraw Hill Publication, New York, 7th Ed., 2004.

3. Singh, S. K.., "Industrial Instrumentation & Control", Tata-McGrawHil, 3rd Ed., 1987.

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Relate various methods for water softening and purification.
CO-2	Illustrate properties of steam.
CO-3	Categorize types and method of Refrigeration.
CO-4	Explain classification of instruments.
CO-5	Discuss different types of measurement devices.
CO-6	Recollect function of relays and interlocks, Control loops, and Process control modes.

List of Open-Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding.

Diploma in Engineering

Subject Code: CH1212

Subject Name: Solid Waste Management

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Open Elective-I

Prerequisite: Fundamental Knowledge of Science and Engineering

Rationale: The course deals with the solid waste management via physical, thermo-chemical and biochemical conversion processes. The major objective of this course is to provide basic knowledge with recent advancements in the technology for the management and utilization of various types of solid wastes.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Source and Type of Solid Waste – Municipal Solid Waste (MSW), Plastic Waste, Industrial Waste, Biomedical Waste, Agro Waste, Forest Waste , Electronic Waste, Composition of Solid Waste and Its Determination.	**6**
2	**Municipal Solid Waste**: Types of Materials Recovered from MSW, Physical, Chemical Properties and Biological Properties of MSW, Preparation of Compost and Refused Derived Fuels (RDF), Recovery of Inorganic Materials, Methods to Measure Solid Waste Quantities, Solid Waste Generation and Collection. Factors Affecting Solid Waste Generation Rate. Handling and Separation of Solid Waste at Site. Material Separation by Physical Methods like Manual, Magnetic, Screening, Electromechanical Separator, Storage of Solid Waste at The Sources and Commercial Site.	**8**
3	**Processing of Solid Waste:** Processing of Solid Waste as Storage, Conveying, Compacting, Shredding, Pulping, Granulating etc.	**4**

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	SECTION-B	
4	**Municipal Solid Waste Management Routes:** Combustion- Energy Recovery from MSW, Effects of Combustion, Undesirable Effects of Combustion. Landfill- Classification, Planning, Sitting, Permitting, Landfill Processes, Landfill Operation, Use of Old Landfill, Differentiate Sanitary Land Fill and Incineration as Final Disposal System of Solid Waste, Biochemical Processes- Methane Generation by Anaerobic Digestion, Composting and other Biochemical Processes.	**8**
5	**Hazardous and Biomedical Waste:** Definition, Identification and Classification of Hazardous Solid Waste. Characteristics of Hazardous Waste Toxicity, Reactivity, Infectiousness, Flammability, Radioactivity, Corrosiveness, Irritation, Bio-Concentration, Genetic Activity, Explosiveness, Bio-Medical Waste- Its Sources, Generation, Storage, Transportation and Disposal.	**6**
6	**Fuel and Chemicals**: Products from Pyrolysis and Gasification of MSW, Argo, Forest, Plastic and E- waste.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	30	15	30	10	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. George, T., "Integrated Solid Waste Management: Engineering Principles and Management Issues", McGraw-Hill Publication, 2002.

Reference Books:

1. Arcadio, P. S., Gregoria, A. S., "Environmental Engineering", Prentice - Hall India, 2nd Ed., 2016.
2. Michael, D. L., Phillip, L. B., Jeffrey C., "Hazardous Waste Management", McGraw-Hill Publication, 2001.

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Subject Name: Solid Waste Management

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Identify different types of solid waste.
CO-2	Summarize processes for recovery of organic and inorganic material from MSW.
CO-3	Distinguish and apply various methods for MSW managements
CO-4	Identify and classify hazardous waste.
CO-5	Design the process for production of bio-methane and compost
CO-6	Describe the various thermo-chemical conversion processes.

List of Open-Source Software/learning website:

1. https://nptel.ac.in/courses/103/107/103107125/

Diploma in Engineering

Subject Code: CH1213

Subject Name: Industrial Water Pollution

Shroff S.R. Rotary Institute of Chemical Technology

Semester: IV

Type of course: Open Elective – I

Prerequisite: Basic Concepts of Chemistry.

Rationale: The objective of this course is to help the students develop the ability to know industrial water pollution. Students will learn the basic understanding of physical, chemical, and biological process for wastewater treatment.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Water Quality Standards for Industrial Wastewater:** Difference between criteria & standards, Stream standards, effluent standards, relevant Indian standards for disposal in to different sinks, costs of pollution control.	6
2	**Physical Unit Processes:** Screening, Flocculation, Flotation, Grit Removal, Primary sedimentation.	6
3	**Chemical Unit Processes:** Fundamentals of Chemical Coagulation, Chemical Phosphorus Removal, Chemical Precipitation for removal of Heavy Metals and Dissolved Substances. Conventional Chemical Oxidation, Chemical Neutralization, Scale control.	6
	SECTION-B	
4	**Biological Treatment:** Role of Microorganisms in wastewater Treatment, Types of Biological Processes for wastewater Treatment, Environmental factors.	8

5	**Oil Pollution:** Sources of oil pollution in industries. Effects of oil pollution, Treatment and removal techniques.	**4**
6	**Pollution Control in Industries:** Treatment of wastewater including recycling & reuse concepts in Textile industry, pharmaceutical industry, Diary industry, sugar industry, fertilize industry, tannery, distillery, pulp & paper industry, petrochemical industry, dye & dye intermediate.	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	35	25	5	5	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Textbooks:

1. Bhatiya, S. C., "Handbook of Industrial Pollution & Control Vol. I & II", CBS Published & distributions, 2002.

Reference Books:

1. James, L. D., and Lee, R.R, "Economics of Water Resources Planning", McGraw-Hill, Newyork, 1971.
2. Mays, L.W., "Water Resources Handbook", McGraw-Hill, 1996.
3. Maass, A., Hufschmidt, M. M., Dorfman, R., Thomas, H. A., Marglin, S. A., Fair, G. M, "Design of Water-Resource Systems", Harvard University Press, 1962.
4. Garg, S. K., "Environmental Engineering, Volume I Water Supply Engineering", Khanna Publishers, 1977.
5. Raju, B. S. N., "Water Supply and Wastewater Engineering", Tata McGraw-Hill, New Delhi, 1995.

Diploma in Engineering

Subject Code: CH1213

Subject Name: Industrial Water Pollution

Course Outcomes:

Students should be able to

Sr. No.	CO statement
CO-1	Memorize standards of industrial wastewater.
CO-2	Interpret the physical processes used in wastewater treatment.
CO-3	Illustrate the chemical processes used in wastewater treatment.
CO-4	Compare the suspended and attached growth process for the treatment of wastewater.
CO-5	Summarize effects of oil pollution on wastewater treatment.
CO-6	Connect treatment of wastewater including recycling and reuse concepts in different industries.

List of Open-Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding.