

(Established under Gujarat Private Universities Act, 2009)

Shroff S.R. Rotary Institute of Chemical Technology

Ref: UPL University/SRICT/BOS/EST/2022-23/01

Date: 28-01-2023

Teaching Scheme for Third Year Diploma in Environmental Engineering

Semester-V (Environmental Engineering) 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	Humanities & Social Sciences	EV1301	Principles of Economics & Management	3	0	0	3	3	70	30	0	0	100
2	Program core course	EV1302	Waste Water Treatment - II	3	0	2	5	4	70	30	20	30	150
3	Program core course	EV1303	Hazardous & Other Waste Management	3	0	2	5	4	70	30	20	30	150
4	Program core course	EV1304	Occupational Health & Safety	3	0	0	3	3	70	30	0	0	100
5	Program Elective course 2	EV1305/1306	Design of Water Treatment Units / Waste Valorisation	3	0	0	3	3	70	30	0	0	100
6	Open Elective 2	EV1307/1308	Fundamentals of Fluid Mechanics/Process Calculations	3	0	0	3	3	70	30	0	0	100
7	Audited course - Indian Constitution	MH1301	Indian Constitution	2	0	0	2	2	50	0	0	0	50
8	Summer Training	MH1302	Industrial Internship	0	0	0	0	3	0	0	50	50	100
Total				20	0	4	22	23	470	180	90	110	850

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Semester-VI (Environmental Engineering) 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 course	EV1309	Wastewater Treatment - III	2	0	2	4	3	70	30	20	30	150
2	Program core course	EV1310	Environmental Impact Assessment	2	0	0	2	2	70	30	0	0	100
3	Program Elective course 3	EV1311/1312	Renewable Energy / Instrumentation Techniques	3	0	0	3	3	70	30	0	0	100
4	Program Elective course 4	EV1313/1314	Environmental Monitoring / Environmental Legislation & Audit	3	0	0	3	3	70	30	0	0	100
5	Open Elective 3	EV1315/1316	Chemical Engineering Process/ Basics of Heat Transfer	3	0	0	3	3	70	30	0	0	100
6	Project	MH1303	Project	0	0	18	18	9	0	0	100	100	200
Total				13	0	20	33	23	350	150	120	130	750

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

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Bachelor of Engineering

Subject Code: EV1301

Subject Name: Principles of Economics & Management

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Humanities & Social Science

Prerequisite: Basic computational skills with rational decision making along with knowledge of mathematics.

Rationale: The course focuses on economic and cost analysis of engineering projects, with basics of economic feasibility studies relating to implementation of projects. The basic purpose of this course is to provide an understanding regarding concepts and principles of engineering economy with methods for making rational decisions for problems encountered in professional practice.

Teaching and Examination Scheme:

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

L-Lectures; T-Tutorial/Teacher Guided Student Activity; P-Practical; C-Credit; ESE-End Semester Examination; PA-Progressive Assessment

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Economic Decisions Making – Overview, Problems, Role, Decision making process Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Recurring And Nonrecurring Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Improvement & Learning Curve, Benefits.	05
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Nominal & Effective Interest. Inflation And Price Change – Definition, Effects, Causes, Types of price Indices, Use of Price Indexes In Engineering Economic Analysis,	10
3	Cash Flow & Rate Of Return Analysis –Treatment of Salvage Value, Annual Cash Flow Analysis, Internal Rate of Return, Calculating Rate of	07

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Bachelor of Engineering

Subject Code: EV1301

Subject Name: Principles of Economics & Management

	Return, Incremental Analysis, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis.	
SECTION-B		
4	Introduction to Management; Definitions, Nature, Management Difference between Management & administration, skill, types and roles of managers Management Principles; Scientific principles, Administrative principles, Maslow's theory	08
5	Functions of Management; Planning, Organizing, Staffing, Directing, Controlling, Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid span of control, departmentalization, chain of command, centralization and decentralization.	06
6	Organizational culture: Concept of culture and its importance, Relationship of organizational culture with managers and employees, Corporate Social Responsibility, Business Ethics; meaning & importance.	06

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)

Recommended Books:

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P and Decenzo David A.
3. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
4. Principles and Practices of Management by L.M.Prasad
5. Principles of Management by Tripathy and Reddy
6. Modern Economic Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publications
7. James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
8. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP

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Bachelor of Engineering

Subject Code: EV1301

Subject Name: Principles of Economics & Management

9. John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley
10. Sullivan and Wicks: Engineering Economy, Pearson
11. R. Paneer Seelvan: Engineering Economics, PHI
12. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Describe the principles of economics that govern the operation of any organization under diverse market conditions
CO-2	Explain various terminologies in economics – Cash flow, Interest, Inflation, and Indexes.
CO-3	Demonstrate methods available for estimating Cash Flow & Rate of return analysis.
CO-4	Identify different management principles along with understanding the difference between administrative and management principles.
CO-5	Brief functions of management along with detailing organizational structures.
CO-6	Summarize the concept of organizational structure along with stressing the need of CSR and Business ethics.

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Bachelor of Engineering
Subject Code: EV1302
Subject Name: Wastewater Treatment - II

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Program Core

Prerequisite: Fundamentals of Wastewater Treatment

Rationale: After studying this course students will be familiar with the preliminary and primary treatment of wastewater.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	Wastewater treatment concepts: Fundamentals of wastewater, Types of wastewater- Domestic & Industrial wastewater, Concept of treatment, Treatment methods, Treatment systems, Selection of treatment system, Functions of treatment plant units.	07
2	Preliminary treatment of wastewater: Screening: Purpose, Classification of screens, Headloss in screens, Screenings handling, processing & disposal. Flow Equalization: Concept, Description of flow equalization, Location of equalization facilities, In line and off line equalization.	07
3	Preliminary treatment of wastewater: Grit chamber: Concept, Grit Removal, Types of Grit chamber: Rectangular horizontal flow, Aerated grit chamber, Vortex type grit chamber, Grit characteristics. Oil & grease: Concept, Sources, Effects, Treatment & removal techniques.	05
SECTION-B		

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Bachelor of Engineering

Subject Code: EV1302

Subject Name: Wastewater Treatment - II

4	Primary treatment of wastewater: Primary Sedimentation: Description, Rectangular tanks, Circular Tanks, Types of settling, Functions of primary sedimentation tank.	07
5	Coagulation & Flocculation: Coagulation tank, feeding devices for coagulation, mixing device of coagulants, types of coagulants, dry feeding and wet feeding of coagulants, Flocculation in wastewater treatment, Energy dissipation in mixing and flocculation.	07
6	Sludge handling and management: Sludge Bulking, Sludge Composting, Sludge Thickening, Sludge volume index, Sludge storage, Landfill sludge for co processing. Introduction & Brief description of Centrifuge, Belt filters press, Filter Press, Decanter, Sludge Drying beds, Double drum dryer.	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	17	13	10	5	5

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

Recommended Books:

1. Wastewater Engineering: Treatment and Reuse, Metcalf & eddy; McGraw Hill Book Company, 4th Ed, 2002.
2. Environmental Pollution and Control engineering, Rao C. S. - Wiley Eastern Limited, India, 1993
3. Water Treatment Plants: Planning, Design & Control, S R Qasim, Technomic Pub. Co., 1999.
4. Industrial Water Pollution Control, Eckenfelder W.W.; McGraw Hill Book Company, 3rd Ed, 2000.
5. Environmental Engineering, Kiely G.; McGraw Hill Book Company, 1998
6. Pollution control in process industries, S.P. Mahajan TMH., 1985.
7. Waste water treatment, M.Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.

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Subject Code: EV1302

Subject Name: Wastewater Treatment - II

8. Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.
9. Environmental Engineering (Vol. II) - Sewage disposal and Air pollution, S.K Garg & Rajeshwari Garg, Khanna Publishers, 27th Edition, 2013.
10. Environmental Engineering and Sanitation: Joseph A. Salvato, John Wiley & Sons, 4th Ed. 2003
11. Water Supply and Sanitary Engineering, Birdie and Birdie, Dhanpatrai and Sons, 1996.
12. Environmental engineering (Vol. I) - Water Supply Engineering S.K Garg & Rajeshwari Garg, Khanna Publishers, 23rd Edition, 2013.
13. Wastewater Treatment concepts & design approach, GL Karia & RA Christian, Eastern economy edition.

List of Practicals:

1. To determine Total Dissolved Solids of wastewater sample.
2. To determine Total Suspended Solids of wastewater sample.
3. To determine Chemical Oxygen Demand of wastewater sample.
4. To determine Biochemical Oxygen Demand of wastewater sample.
5. To determine Dissolved Oxygen of wastewater sample.
6. To determine Coagulant Dose using Jar test Apparatus by varying coagulant dose.
7. To determine Coagulant Dose using Jar test Apparatus by varying pH of sample.
8. To determine Oil & Grease of wastewater sample.
9. To determine Ammonical Nitrogen of wastewater sample.
10. To determine Most Probable Number (MPN) in wastewater sample

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Bachelor of Engineering

Subject Code: EV1302

Subject Name: Wastewater Treatment - II

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the basic treatment concepts of wastewater engineering.
CO-2	List out different preliminary treatment of wastewater.
CO-3	Explain the importance of grit and oil removal from wastewater before primary treatment.
CO-4	Outline the purpose of primary wastewater treatment.
CO-5	Differentiate between coagulation and flocculation of wastewater.
CO-6	Summaries available techniques for management and handling of sludge.

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Bachelor of Engineering

Subject Code: EV1303

Subject Name: Hazardous & Other Waste Management

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Professional Core

Prerequisite: Students shall have basic understanding regarding sources, generation, characteristics, storage, handling, treatment and disposal options for the hazardous waste.

Rationale: To gain some knowledge about hazardous waste management practices.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	Overview of Hazardous waste: Introduction, Definition, Sources, Identification & Characteristics, Hazardous waste & Other Waste (Management and Transboundary) Rules, 2016, Waste Hierarchy, Hazardous waste lists- Hazardous waste from Nonspecific sources, Hazardous waste from Specific sources.	05
2	Pathways, Fates and Disposition of hazardous waste releases: Introduction, Releases of chemicals to the environment- Releases to the atmosphere, Releases to surface water and releases to land, Movement, Fates and Disposition- Behavior of waste constituents released to atmosphere, Movement of hazardous waste constituents in surface water and Pathways of hazardous waste constituents reaching groundwater.	07
3	Handling of hazardous waste: Collection of hazardous wastes and care in handling quantities of hazardous wastes generated, Storage of hazardous waste, Scope and modes of hazardous waste transportation, Transportation requirements.	07
SECTION-B		

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Bachelor of Engineering

Subject Code: EV1303

Subject Name: Hazardous & Other Waste Management

4	Treatment methods: Hierarchy of sustainable waste management, Overview of Physico-chemical, biological and thermal methods, Composting, Incineration, Solidification, Stabilization, Waste minimization, Waste Exchange.	08
5	Disposal of Hazardous waste: Siting and locational criteria; Planning and design criteria- Essential components, Landfill layout, Phased operation, Liner system, Leachate management, Gaseous emissions management, Final cover system, Surface water drainage system, Utilization of closed landfill site, Environmental monitoring system, Closure and Post closure maintenance plan.	07
6	Biomedical Waste Management: Definition, Sources, Generation, Classification, Storage, Transportation, Treatment techniques, Disposal. E-Waste Management: Definition, Sources, Generation, Categories Recovery & Recycling technologies, Disposal. Construction & Demolition Waste Management: Salient features of Construction & Demolition Waste Management Rules, 2016.	05

Suggested Specification table with Marks (Theory):

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

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

Recommended Books:

1. Hazardous Waste Management by M LaGrega and others, McGraw-Hill Publication.
2. Solid & Hazardous waste Management by PM Cherry.
3. Hazardous Waste Management by Sukalyan Sengupta.
4. Basic Hazardous Waste Management by William C. Blackman.
5. Manual on Municipal Solid waste management by Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

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Subject Code: EV1303

Subject Name: Hazardous & Other Waste Management

6. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management”, the McGraw- Hill, New York, 3rd Ed., 1993.
7. Waste Management Practices-Municipal, Hazardous and Industrial by John Pichtel.

List of Practicals:

1. To determine the concentration of Sodium in given solid waste sample by Flame photometer.
2. To determine the concentration of Potassium in given solid waste sample by Flame photometer.
3. To determine the Calorific value of a given sample using Bomb Calorimeter.
4. To determine the moisture content in a given hazardous waste sample.
5. To demonstrate hazardous waste landfill model.
6. To determine the total chloride in given sample of solid waste using Bomb Calorimeter.
7. To determine the total sulfur content in given sample of solid waste using Bomb Calorimeter.
8. Study the storage and transportation of hazardous waste.
9. To design appropriate E-waste management facilities.
10. Study the identification and characteristics of hazardous waste.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Outline the concept, sources, characteristics and types of hazardous waste.
CO-2	Describe the pathways, fates and disposition of hazardous waste releases.
CO-3	Understand the handling and transportation of hazardous waste.
CO-4	Learn various treatment technologies to deal with hazardous solid waste.
CO-5	Select the appropriate methods for disposal of hazardous waste.
CO-6	Explain the methods to handle different types of waste.

List of Open-Source Software/learning website:

NPTEL

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Bachelor of Engineering
Subject Code: EV1304
Subject Name: Occupational Health & Safety

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Program Core

Prerequisite: Fundamental knowledge of industrial safety.

Rationale: The main objective of this subject is to make students aware about the importance of safety in industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	Importance of Industrial Safety, Ergonomics at Work Place: Ergonomics Task analysis, Controlling Ergonomic Hazards, Types of hazard (a) Chemical hazard (b) Thermal hazard (c) Electrical hazard (d) Mechanical hazard (e) Vibrational hazard (f) Biological hazard (g) Radioactive hazard.	5
2	International standard: OHSAS 18001, Classification of Chemical Hazards and their control, Occupational diseases.	5
3	Concept of safety, safety terminology, Accident Causes and prevention: Causation, Accident problem, Reasons for prevention, Factors impeding safety, Accident prevention.	8
SECTION-B		
4	Personal Protective Equipment: Need of PPE, factors of selection of PPE, non-respiratory equipment's, respiratory equipment's.	8
5	Fire hazards & their causes, Fire Triangle, Classes of fire, Fire extinguishers, Classes of fire & types of extinguishers.	5
6	Hazard identification methods : a) Hazard Operability study (HAZOP),	8

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Bachelor of Engineering

Subject Code: EV1304

Subject Name: Occupational Health & Safety

	b) Hazard Analysis (HAZAN), Risk Assessment methods: a) Failure mode and effect analysis (FMEA) b) Fault Tree analysis (FTA) c) Event Tree analysis (ETA).	
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	10	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. Fundamentals of Industrial safety & health by Dr. K. U. Mistry.
2. Industrial & occupational Safety, Health & Hygein - by AHommadi.
3. Occupational Health, a Practical Guide for Managers -by Ann Fingret & Akin Smith.
4. Industrial Safety by K.U Mistry

Course Outcomes:

Sr. No.	CO statement
CO-1	Explain International Safety standards.
CO-2	Identify the causes of accident and explain various engineering control methods.
CO-3	Classify fire extinguishing agents and methods.
CO-4	Knowledge about risk assessment methods.
CO-5	Carry out HAZAN and HAZOP analysis.
CO-6	Manage safety in industries by suggesting safety measures and PPE.

List of Open Source Software/learning website:

- <http://nptel.ac.in>

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Bachelor of Engineering

Subject Code: EV1305

Subject Name: Design of Water Treatment Units

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Program Elective 2

Prerequisite: Students should have basic knowledge of sources of water, types of water pollutions, its effects and water quality standards.

Rationale: Water constitutes one of the most important physical environment of the living being and has direct bearing on the health of human being. Due to this it becomes important to design such a water supply scheme which can provide potable water to the community in accordance with the demand and quality requirements. This subjects provide knowledge related to the designing of wastewater treatment units.

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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 Treatment Plant: Introduction, Layout and section of water treatment plant, estimation of raw water discharge for treatment plant: domestic or residential water demand, industrial water demand, institutional and commercial water demand, demand for public uses, fire demand, water required to compensate losses and thefts, per capita demand, Factors affecting rate of demand, variation in rate of demand, design period: factors influencing the selection of design period, design period values, population forecast, local treatment of plant, selection of treatment train.	5
2	Quality, Quantity of Water: Quality of water and wastewater, Wholesome water, Impurity of water, Characteristics of water, Examination of water, Sources of water and water treatment schemes: (i) Regulatory water quality standards (ii) Selection criteria (iii) Surface water treatment. (iv) Ground water treatment, Flow measuring devices for water treatment.	6

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Bachelor of Engineering

Subject Code: EV1305

Subject Name: Design of Water Treatment Units

3	<p>Collection and Conveyance of raw water from source: Introduction, Intakes: factors governing the location of intake, Types of intake: river intake, canal intake, lake intake, Conveyance of water: open channels, aqueducts, tunnels, flumes, pipes, Pipes joints: spigot and socket joint, expansion joint, flanged joint, mechanical joint, flexible joint, screwed joint, collar joint, laying of water supply pipes, Hydrostatic test, Pumps for lifting water: Classification of pumps, Design of rising main: economical diameter of rising or pumping main, head loss in rising main</p>	7
SECTION-B		
4	<p>Sedimentation, Coagulation and Flocculation: Introduction, Water Treatment Process, screening, Plain sedimentation: types of settling, theory of sedimentation, types of sedimentation tanks, design aspects of continuous flow type of sedimentation tanks, aeration: objective, method, types, sedimentation aided with coagulation: theory of coagulation, types of coagulants, dosage of coagulants, determination of optimum coagulant dose, feeding devices of coagulants, mixing devices, Flocculation: design of flocculator, Clarifier, Clariflocculator</p>	8
5	<p>Filtration, disinfection and water softening: Filtration, theory of filtration, filter materials, types of filter, rapid and slow sand filter, design of rapid and slow filter, disinfection: requirement of a disinfectants, mechanism of disinfection, methods of disinfection, chlorination, Water softening: types of hardness and methods of their removal, lime soda, zeolite process, demineralization or deionization process</p>	7
6	<p>Distribution System: Introduction: components of distribution system, requirement of a good distribution system, layout of distribution network, methods of water distribution/ system of distribution, storage and distribution reservoirs: types of storage and distribution reservoirs, location and height of the distribution reservoir, capacity of distribution reservoir, Network analysis by using hardy Cross and Newton- Raphson method.</p>	6

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)

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Bachelor of Engineering

Subject Code: EV1305

Subject Name: Design of Water Treatment Units

Recommended Books:

1. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw-Hill Publication, New Delhi, 2003.
2. Water and Wastewater Engineering by B.R. Shah, A.M. Malek, Mahajan Publishing House
3. Water & Waste Water Engineering by Fair and Gayer.
4. Environmental Engineering by Peavy, H.S., Rowe, D.R. and Tchobanoglous, G., McGraw Hills, New York 1985.
5. Water Quality and Treatment (A handbook of community water supplies 5th edition): Published by American Water Works Association
6. Water Works Engineering Planning, Design & operation by Syed R Qasim, Edward M Motley & Guang Zhu Published by Prentice Hall of India.
7. Environmental modeling: Fate & transport of pollutants in Water, Air and Soil by Jerald L Schnoor.
8. Environmental Engineering – A design approach by Arcadio P. Sincero & Grecjoria A. Sincero (Prentice Hall of India).
9. Wastewater Engineering by Dr. B.C Punamia, Er. Ashok Jain, Dr. Arun Jain
10. Text book of Water supply and Sanitary Engg., S K Hussain.
11. Design of Water Treatment Plants by Dr A G Bhole Published by Indian Water Works Association
12. Water Supply and Sanitary Engg., G S Birdi.
13. Water Quality and treatment Published by American Water Works Association
14. A text book of Water Supply, V N Gharpure.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Recognize various types of water demand considering future projection of population and to understand the outline of a Water Treatment Plant.
CO-2	Estimate the quality and quantity of water.
CO-3	Choose appropriate collection and conveyance of raw water from source.
CO-4	Illustrate the fundamentals of sedimentation, coagulation and flocculation.
CO-5	Sumarise the concept of filtration, disinfection and water softening.
CO-6	Explain the components and requirement of a good distribution system.

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Bachelor of Engineering
Subject Code: EV1306
Subject Name: Waste Valorization

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Program Elective 2

Prerequisite: Students shall have basic knowledge regarding energy recovery from waste.

Rationale: To understand different waste valorization routes.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	Historical Background and Perspective Introduction to waste concept, Energy supply and waste management, Evolution of Waste Management Practices and Socio-Industrial Metabolism, SWM Rules, 2016: Guidance on Waste to energy- Clause 15, 18 and 21, Circular economy and waste valorization.	06
2	Waste valorization routes Overview of the Torrefaction, Liquefaction, Incineration, Combustion, Pyrolysis, Gasification, Fermentation, Anaerobic digestion. Recovery of materials from MSW- RDF, Bio-compost, Inorganic materials.	08
3	Thermochemical conversion: Torrefaction, Liquefaction, and Pyrolysis Objectives of torrefaction, Liquefaction of biomass and algae. Pyrolysis: Basic concept, Feed stock for pyrolysis including E-Waste, Types of pyrolysis- slow, fast and flash pyrolysis, Environmental applications of pyrolysis, Advantages of pyrolysis.	07
SECTION-B		

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Bachelor of Engineering
Subject Code: EV1306
Subject Name: Waste Valorization

4	Thermochemical conversion: Gasification and Combustion Concept of Gasification, Gasification Reactions, Different types of reactors used for gasification, Environmental effects of gasification. Combustion: Types of Combustion systems- Mass Fired combustion system, Fluidized bed combustion system, RDF-Fired combustion system.	06
5	Biochemical conversion Anaerobic conversion, Biogas, Effect of operating parameters, Biogas compositions, Biogas cleaning and up-gradation to bio methane, Benefits, drawbacks and applicability of biogas systems; Types of anaerobic digesters in use.	07
6	Environmental impact for waste valorization Environmental issues- Air emissions (Nitrogen oxides, Sulphur Dioxide, Carbon Monoxide, Particulate matter), Metals, Acid gases, Dioxins, etc., Compatibility of waste valorization with recycling, Integrated planning, Future trends.	05

Suggested Specification table with Marks (Theory):

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

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

Recommended Books:

1. Waste valorization: Waste streams in Circular Economy by Carol Sze Ki Lin, Guneet Kaur, Chong Li and Xiaofeng Yang- Wiley.
2. Waste to Energy Conversion Technology by Naomi B. Klinghoffer and Marco J. Castaldi.
3. Waste to Energy Technologies and Global Applications by Efstratios N. Kalogirou.
4. Waste to Energy: Recent Developments and Future Perspectives towards Circular economy by Abd El-Fatah Abomohra Qingyuan Wang Jin Huang.
5. Biogas Technology by B.T. Nijaguna, New age international Ltd, New Delhi, 2009.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1306
Subject Name: Waste Valorization

6. Emerging Technologies for Waste valorization and Environmental Protection by Sadhan Kumar Ghosh, Chiranjib Bhattacharya, Suggala V. Satyanarayana, S. Varadarajan.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the concept of waste valorization and relate it with circular economy.
CO-2	Study the different waste valorization routes.
CO-3	Explain torrefaction, liquefaction and pyrolysis based thermochemical processes.
CO-4	Compare different types of Gasifiers and Combustion system used for thermal conversion.
CO-5	Recollect the concept of biochemical processes.
CO-6	Rectify the environmental challenges and sustainable approaches for waste valorization.

List of Open-Source Software/learning website:

NPTEL

Bachelor of Engineering

Subject Code: EV1307

Subject Name: Fundamentals of Fluid Mechanics

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Open Elective 2

Prerequisite: Basic knowledge of physics and units and dimensions. Mathematical background is also essential in this respect.

Rationale: This subject is intended to make students aware about types and behaviour of fluid with the fundamentals underlying the operation of fluid for Environmental Science & Technology students. Apparently, the subject aims at measurement techniques involved for the pressure concepts, fluid flow and equipments used for the transportation of fluids.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	Properties of fluids and Fluid flow phenomena Units and dimensions. Properties of fluids. Nature of fluids: incompressible and compressible. Hydrostatic equilibrium. Manometers, types of manometers. Potential flow and laminar flow. Newtonian and non-Newtonian fluids, Newton's-law of viscosity, turbulence, Reynolds number. Rheological classification of fluids.	05
2	Kinematics of Fluid flow Bernoulli equation, pump work in Bernoulli equation. Flow of incompressible fluids. Shear stress distribution in pipes. Velocity distribution in pipes. Friction factor, relationships between skin-friction parameters. Hagen-Poiseuille equation.	06
3	Flow past immersed objects Drag and drag coefficients of typical shapes. Ergun's equation for packed bed. Terminal settling velocity, free and hindered settlings. Flow regimes: Stokes' law and Newton's law.	07

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1307

Subject Name: Fundamentals of Fluid Mechanics

SECTION-B		
4	Transportation of fluids Introduction to: pipe and tubing, joint and fittings. Gate valves and globe valves, plug cocks and ball valves, check valves. Reciprocating and Centrifugal pumps.	07
5	Flow Metering Constructional features and working principles of venturimeter. Constructional features and working principles of orificemeter. Rotameters, pitot tube. Discharge coefficients.	07
6	Agitation and Mixing Principles of agitation, agitation equipment, flow patterns: prevention of swirling, baffles and draft tubes. Types of agitated vessels.	07

Suggested Specification table with Marks (Theory):

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

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

Recommended Books:

1. Gavhane K.A.. “Unit Operations – I” Nirali Publications (2017).
2. Foust A. S. & associates, “Principles of Unit Operations” John Wiley and Sons (1980).
3. McCabe Smith, “Unit Operation in Chemical Engineering” 5th ed. McGraw Hill (1985).
4. S. K. Gupta, “Momentum Transfer Operation”. Tata McGraw Hill (1979)
5. Coulson and Richardson: Chemical Engineering, Vol. 2. Butterworth Heinemann Pub

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
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(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1307

Subject Name: Fundamentals of Fluid Mechanics

CO-1	Identify and classify fluids based on their physical properties.
CO-2	Discuss and classify various flow situations with forces acting on fluid element
CO-3	Develop and illustrate the principle of flow past immersed bodies.
CO-4	Analyze various fluid moving machineries.
CO-5	Summarize the different practical applications of metering of fluids.
CO-6	Interpret the equipments used for agitation and mixing of fluids.

List of Open-Source Software/learning website:

- NPTEL

Shroff S.R. Rotary Institute of Chemical Technology

Semester V

Type of course: Open Elective 2

Prerequisite: Students need to have basic knowledge regarding concepts of Fundamental Mathematics and Chemistry

Rationale: The main objective of this subject is to make students aware about the basics of material and energy balance for different types of Unit Operations carried out in Industries. The calculations are important from the point of view of reducing losses thereby increasing the overall economy of the plant. Importance of Unit conversions, material and energy balance calculations involved in other unit operations like Mechanical Operations, Fluid flow, Heat Transfer and Mass Transfer also need to be detailed to students.

Teaching and Examination Scheme:

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

L-Lectures; T-Tutorial/Teacher Guided Student Activity; P-Practical; C-Credit; ESE-End Semester Examination; PA-Progressive Assessment

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Units & Dimensions: Dimensions & system of units, Fundamental and derived units, Unit conversion and its significance.	05
2	Basic Chemical Calculations: Concepts of Atomic weight, equivalent weight and mole. Composition of Solids, Liquids and Solutions (weight percent, mole percent, molarity, normality, ppm etc) Average molecular weight and density, Gaseous mixtures, Ideal gas law, Real gas laws and their applications, Raoult's law and their applications, Henry's law, Amagat's law and Dalton's law	08
3	Material Balances without Chemical Reactions: Material balance with and without recycle, Bypass, Purge Streams, Material balance around equipments related to unit operations like absorber and stripper, Distillation towers, Extractors, Dryers, Evaporators, Crystallizer, Steady state & Unsteady state process, Water balance.	07

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Bachelor of Engineering

Subject Code: EV1308

Subject Name: Process Calculations

SECTION-B		
4	Material balances with Chemical Reactions: Concept of limiting and excess reactants, percentage conversion and yield. Material balance involving chemical reactions at Steady state.	06
5	Energy Balances: Forms of energy, Concepts of C_p and C_v , Calculation of enthalpy change, Sensible heat change in liquids and gases, Enthalpy changes during phase transformation, Thermochemistry involving calculations of Heat of combustion, reaction and formation. Simple Energy balance problems	07
6	Combustion Types of fuels, calorific value, Proximate & Ultimate analysis Simple problems to find out the air requirement for combustion & composition of exit gases etc.	06

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)

Recommended Books:

1. Stoichiometry & Process Calculations, Narayanan K.V., &Lakshmikutti B., Prentice Hall, 2006
2. Basic Principles & Calculations in Chemical Engineering, D.M.Himmelblau. 6th Ed., 2004
3. Stoichiometry, B.I.Bhatt & Thakore, Tata McGraw Hill Book Company, 5th Ed, 2010
4. Chemical Process Principles, Vol.1, O.A.Hougen, K.M.Watson, R.A.Ragatz., Indian print, CBS Publishers, 2nd Ed., 1995
5. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004
6. Optimization of Chemical Processes, T F Edgar, D M Himmelblau and L S Lasden, Tata McGraw Hill, 2001

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1308
Subject Name: Process Calculations

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify different system of units and dimensions with conversion
CO-2	Distinguish concepts for expressing compositions and behavior of different gases and solutions
CO-3	Demonstrate material balance in steady state and unsteady state unit operation with and without recycle.
CO-4	Analyze the material balance involving chemical reactions in a fertilizer, petrochemical, dyestuff and electrochemical industries.
CO-5	Describe energy changes in liquid and gases accompanying various chemical reactions with terms used to associate energy changes in different phases
CO-6	Evaluate fuel quality and to device requirement of gases in combustion.

List of Open-Source Software/learning website:

- NPTEL
- WRPLOT

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: MH1301
Subject Name: Indian Constitution

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Mandatory course

Prerequisite: Zeal to learn the Constitution

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	50		0	0	50

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction to Constitution: Meaning and importance of the Constitution, History of Indian Constitution, salient features of Indian Constitution. Preamble of the Constitution.	3
2	Fundamental Rights: Fundamental rights – meaning and limitations, Right to equality, Right against exploitation, Right of freedom of religion Cultural and educational rights, Right to property, Directive principles of state policy.	7
3	Fundamental Duties: Fundamental duties -their enforcement and their relevance.	3
SECTION-B		
4	Union Government: Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature- Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India – composition and powers and functions.	5
5	State Government:	5

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: MH1301

Subject Name: Indian Constitution

	State Executive- Governor, Chief Minister, Council of Ministers. State Legislature-State Legislative Assembly and State Legislative Council. State Judiciary-High court.	
6	Election provisions, Emergency provisions, Amendment of the constitution Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution- meaning, procedure and limitations.	5

Total L - 28 Hours

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	0

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

Course Outcomes:

At the end of the course the student should be able to:

CO 1	Understand and explain the significance of Indian Constitution as the fundamental law of the land.	
CO 2	Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.	
CO 3	To Understand the Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsibilities.	
CO 4	Analyse the Indian political system, the powers and functions of the Union Governments in detail.	
CO 5	Analyse the Indian political system, the powers and functions of the State and Local Governments in detail	
CO 6	Understand Electoral Process, Emergency provisions and Amendment procedure.	

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: MH1301
Subject Name: Indian Constitution

Textbooks

1. M.V.Pylee, “Introduction to the Constitution of India”, 4th Edition, Vikas publication, 2005.
2. Durga Das Basu (DD Basu) , “Introduction to the constitution of India”, (Student Edition), 19th edition, Prentice-Hall EEE, 2008.
3. Constitution of India. D. D. Basu. (Prantice Hall of India Pvt. Ltd., New Delhi)
4. Constitution of India. D. K. Singh. (Eastern Book Company, Lucknow)
5. Constitution of India (P M Baxi)
6. Constitutional Law of India, Dr. J.N. Pandey, Central Law Agency
7. Introduction to the Consitution of India, Durga Das Basu, LexisNexis.
8. Indian Constitutional Law, M.P. Jain, LexisNexis
9. V.N.Shukla’s Constitution of India, Mahndra Pal Singh, Eastern Book Company
10. Constitutional Law – I Structure, Udai Raj Rai, Eastern Book Company

Reference Book

1. Merunandan, “Multiple Choice Questions on Constitution of India”, 2nd Edition, Meraga publication, 2007.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1309
Subject Name: Wastewater Treatment – III

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Professional Core

Prerequisite: Fundamental of wastewater treatment.

Rationale: The main objective of this subject is to make students aware about the biological treatment of wastewater.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				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	Fundamentals of Biological Treatment: Concept of biological treatment, Removal mechanism, Objectives of biological treatment, Classification of treatment process, Aerobic biological treatment, Role of microorganism in wastewater treatment.	06
2	Microbial Growth Kinetics: Introduction to microbial metabolism, Bio kinetic coefficients, significant bio kinetic coefficient: specific growth rate, yield coefficient, maximum substrate utilization rate constant, half velocity constant, endogenous decay coefficient, MCRT, F/M ratio.	06
3	Aerobic suspended growth biological treatment systems: Aerobic Biological oxidation, Process description, environmental factors, Modification in ASP: Complete Mix activated sludge, Extended Aeration system, Oxidation Ditch systems, Intermittently aerated and decanted systems, Oxygen activated sludge, Oxidation ponds, stabilization ponds, Secondary settling tank.	07
SECTION-B		

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1309

Subject Name: Wastewater Treatment – III

4	Aerobic attached Growth Biological Treatment systems: Introduction to attached growth systems, Trickling Filter, Oxygen transfer and utilization, Applications rotating biological contactors, Bio-Towers, Design Examples for rotating biological contactor, trickling filter, Sludge volume index.	07
5	Anaerobic Biological Wastewater Treatment: Introduction, Removal Concept, System concept, design considerations, design procedure and criteria, anaerobic reactors (attached growth reactors): Packed bed reactor, extended bed reactor, anaerobic reactors (suspended growth reactors): complete mix reactor, contact reactor.	07
6	Anaerobic biological wastewater treatment: Introduction, Removal Concept, Design Considerations, Anaerobic reactors, Fluidized bed reactor, Up flow Anaerobic sludge blanket reactor, high rate and multi stage anaerobic digesters.	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	10	5	5

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

Recommended Books:

1. Wastewater Engineering: Treatment and Reuse, Metcalf & eddy; McGraw Hill Book Company, 4th Ed, 2002.
2. Environmental Pollution and Control engineering, Rao C. S. - Wiley Eastern Limited, India, 1993
3. Water Treatment Plants: Planning, Design & Control, S R Qasim, Technomic Pub. Co., 1999.
4. Industrial Water Pollution Control, Eckenfelder W.W.; McGraw Hill Book Company, 3rd Ed, 2000.
5. Environmental Engineering, Kiely G.; McGraw Hill Book Company, 1998.
6. Pollution control in process industries, S.P. Mahajan TMH., 1985.
7. Waste water treatment, M.Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.
8. Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1309

Subject Name: Wastewater Treatment – III

9. Environmental Engineering (Vol. II) - Sewage disposal and Air pollution, S.K Garg & Rajeshwari Garg, Khanna Publishers, 27th Edition, 2013.
10. Environmental Engineering and Sanitation: Joseph A. Salvato, John Wiley & Sons, 4th Ed. 2003
11. Water Supply and Sanitary Engineering, Birdie and Birdie, Dhanpatrai and Sons, 1996.
12. Environmental engineering (Vol. I) - Water Supply Engineering S.K Garg & Rajeshwari Garg, Khanna Publishers, 23rd Edition, 2013.
13. Wastewater treatment concepts and design approach: GL Karia & R.A Christian.

List of Practical:

1. To determine Mix Liquor Suspended Solids of wastewater sample.
2. To determine Mix Liquor Volatile Suspended Solids of wastewater sample.
3. To determine Sludge Volume Index of wastewater sample.
4. To determine colour of wastewater sample.
5. To determine Mercury concentration of wastewater sample.
6. To determine Lead concentration of wastewater sample.
7. To determine Chromium concentration of wastewater sample.
8. To determine Chlorine Dose of a wastewater sample using chlorinator.
9. To determine Ozone Dose of a wastewater sample using Ozonator.
10. To determine disinfection property using UV chamber of a wastewater sample.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Explain biological treatment based on the role of microorganism for removal of organics from wastewater.
CO-2	Analyze microbial growth kinetics responsible for the growth of microorganism in wastewater.
CO-3	Select suspended aerobic biological treatment process according to the characteristics of wastewater.
CO-4	Classify attached aerobic biological treatment process according to the characteristics of wastewater.
CO-5	Differentiate aerobic and anaerobic biological treatment process.
CO-6	Enlist different anaerobic biological treatment used for wastewater.



(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1309
Subject Name: Wastewater Treatment – III

List of Open-Source Software/learning website:

- NPTEL

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1310

Subject Name: Environmental Impact Assessment

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Program Core

Prerequisite: Students shall have basic knowledge of environmental impact assessment and audit.

Rationale: To provide knowledge related to Environmental Impact Assessment studies for making decision for better environmental management. The major components and processes of EIA systems will be dealt in the course. The course will also introduce different aspects and methodologies of planning and managing an EIA study.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Concepts of Environmental Impact Assessment: Concepts of EIA: Definitions, Environment; Environmental Impacts; Environmental Impact Analysis; Environmental Impact Assessment; Classification of impacts, Need for EIA	06
2	EIA Notification and Categorization of Project: EIA Notification September 2006 and amendments: Categorization of projects, Public participation in environmental decision making process, Environmental Clearance notification 2006 & its amendments, Change in product mix.	07
3	Environment Attributes and Setting: Environmental attributes: Air, Water, Noise, Socioeconomic, Cultural and biological, Purposes of defining the Environmental Setting, Inclusion or Exclusion of Environmental Items, Carbon and water footprint.	07
SECTION-B		

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1310

Subject Name: Environmental Impact Assessment

4	Baseline studies: Purpose, Selection of parameters, Monitoring of physical environmental parameters, Collection and interpretation of baseline data for various environmental attributes	06
5	EIA Methodologies: Criteria for selection of EIA methodology; Checklist methodology and its types, Matrix and its types, Networks methodology, Overlay method	07
6	Prediction and Methods of Assessment: Prediction and methods of assessment of impacts on various attributes of Environment, Air quality impact assessment, Noise impact assessment, Water quality impact analysis	06

Suggested Specification table with Marks (Theory):

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

Recommended Books:

1. Environmental Impact Assessment – by A. K. Shrivastava
2. Environmental Impact Assessment – by R. R. Barthwal; New Age International publishers.
3. Environmental Impact Analysis Handbook – by Rau Whooten; McGraw Hill publications
4. Environmental Impact Assessment – by Larry Canter; McGraw Hill publications
5. Environmental Impact Analysis – A Decision Making Tool by R K Jain
6. Handbook of Environment Impact Assessment by Judith Petts; McGraw Hill publications.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1310

Subject Name: Environmental Impact Assessment

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Appreciate the importance of EIA as an integral part of planning process.
CO-2	Execute EIA Process as prescribed in EIA Notification
CO-3	Identify the environmental attributes to be considered for the EIA study.
CO-4	Enumerate the role of public participation in environmental decision making process.
CO-5	Apply the different methodologies to predict and assess the impacts of project on various aspects of environment.
CO-6	Carry out EIA studies including description of environment using environmental attributes and prepare the EIA report.

List of Open-Source Software/learning website:

- NPTEL
- Website of GPCB, MoEF, CC & CPCB.

Shroff S.R. Rotary Institute of Chemical Technology

Type of course: Program Elective 3

Prerequisite: A basic understanding regarding various forms of energy and sources is required. Fundamental knowledge of fluid mechanics and heat transfer is also needed.

Rationale: The course is designed to give a fundamental knowledge for students regarding various renewable energy sources. The course will teach the students challenges faced by various technologies for harnessing energy from various renewable energy sources. It also makes them aware regarding current and future role of energy sources emphasizing on methodologies to derive maximum energy out of these energy sources.

Teaching and Examination Scheme:

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

L-Lectures; T-Tutorial/Teacher Guided Student Activity; P-Practical; C-Credit; ESE-End Semester Examination; PA-Progressive Assessment

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction to Renewable Energy systems: Principles of renewable energy; energy and sustainable development, fundamentals, and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale.	06
2	Solar Energy: Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.	08
3	Wind Energy: Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generators.	06
SECTION-B		

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1311

Subject Name: Renewable Energy

4	Ocean Energy & Geothermal Energy: Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants. Introduction to Geothermal energy resources, types of wells, methods for harnessing energy, advantages and disadvantages, Applications.	08
5	Energy from Biomass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.	05
6	Energy Conservation: Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves, Energy Management & Audit, Waste heat recovery system, hydrogen cell, E-Vehicles.	06

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)

Recommended Books:

1. S. Rao, B.B. Parulekar, "Energy Technology", Khanna Publishers, 3rd Edition, 2018.
2. G .D Rai, "Non Conventional Energy Sources", Khanna Publishers, 6th Edition, 2004.
3. S. C. Bhatia, R. K. Gupta, " Textbook of Renewable Energy", Woodhead Publishing India Pvt Ltd
4. Vinod Thombre-Patil , Apeksha Thombre-Patil, " Renewable Energy Technologies", Nirali Prakashan, 1st Edition, 2020

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Describe the need, importance, and scope of non-conventional and alternate energy resources.

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Bachelor of Engineering
Subject Code: EV1311
Subject Name: Renewable Energy

CO-2	Explain the various techniques used in power generation through solar energy.
CO-3	Demonstrate the different types of Wind energy systems and factors affecting power generation through Wind turbine generators
CO-4	Analyze the principle of operation for ocean thermal energy & geothermal energy with relevant applications.
CO-5	Summarize the various methodologies available for utilization of energy from biomass.
CO-6	Summarize principles of energy conservation through Energy management principles and audit.

List of Open-Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - V

Type of course: Program Elective 3

Prerequisite: Basic knowledge of physics, units and dimensions. Mathematical background is also essential in this respect.

Rationale: The main objective of this subject is to make students aware about the importance of instrumentation in Environmental Science and Technology. This subject also aims at providing students rich knowledge of various qualitative and quantitative analyses.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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 Terms associated with analytical techniques –accuracy/precision- common errors (system/manual) – calibration curves - basics of classification of instrumental methods - spectroscopy, electrochemical and chromatography, advantages and limitations of instrumental analysis - electro-magnetic (EM) spectrum – interaction of EM radiation with matter – laws of absorption. Instruments for quantitative and qualitative analysis.	05
2	Spectroscopic Techniques UV –Vis spectroscopy- instrumentation – measurements - applications - instrumentation and applications of IR spectroscopy - instrumentation and applications of emission and atomic absorption spectrophotometers.	06
3	Chromatographic Techniques Gas Chromatography- principles of gas chromatographic separations - description of instrument. Principles of GC – instrument description – applications.	07

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1312

Subject Name: Instrumentation Techniques

	Liquid chromatography – Introduction and principles of liquid chromatography. Principles of HPLC – instrument description – applications.	
SECTION-B		
4	Temperature Measuring Instruments Temperature Scales, Expansion thermometers like constant volume gas, Mercury in glass. Thermoelectric temperature measurement: Thermocouples, Pyrometers: Radiation pyrometer, Photo electric pyrometers, Optical pyrometers.	07
5	Pressure Measuring Instruments Liquid column manometer, Enlarged leg manometer, Inclined tube manometer. Bourdon gauge, Bellows, Bellows differential pressure gauge.	07
6	Level Measuring Instruments Direct measurement, Float and tap, Float and shaft, Hydraulic remote transmission, Bubbler system, Diaphragm & air trap system, Differential pressure manometer, Float and spring pneumatic balance.	07

Suggested Specification table with Marks (Theory):

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

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

Recommended Books:

1. Gavhane K.A. “Unit Operations – I” Nirali Publications (2017).
2. Foust A. S. & associates, “Principles of Unit Operations” John Wiley and Sons (1980).
3. McCabe Smith, “Unit Operation in Chemical Engineering” 5th ed. McGraw Hill (1985).
4. S. K. Gupta, “Momentum Transfer Operation”. Tata McGraw Hill (1979)
5. Coulson and Richardson: Chemical Engineering, Vol. 2. Butterworth Heinemann Pub

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1312
Subject Name: Instrumentation Techniques

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify and classify terms associated with instrumentation.
CO-2	Discuss and classify various spectroscopic techniques.
CO-3	Develop and illustrate the principles of chromatographic techniques.
CO-4	Analyze various temperature measuring instruments.
CO-5	Summarize the different practical applications of pressure measuring instruments.
CO-6	Interpret the different instruments for level measurement.

List of Open-Source Software/learning website:

- NPTEL

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Professional Elective 4

Prerequisite: Knowledge of subjects Environmental Sciences.

Rationale: Analysis of water, wastewater and air samples is the first step towards designing treatment technologies for water, waste water and air pollution control. Much information can be obtained by statistical analysis of the data on environmental parameters. This subject aims at equipping the student with methods of monitoring and managing the data generated.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Environmental Monitoring: Purpose of monitoring, Scales of observation, Environmental characteristics, Representative units, Sampling Location, Types of environmental monitoring, Sampling plan, Analytical data quality requirements: Precision and Accuracy, Detection limits, Reporting data.	7
2	Water Quality Monitoring Sampling techniques, Preservation of water sample, Physical Properties of water & its monitoring: Temperature, Conductivity, Turbidity etc., Chemical Properties of water & its monitoring 1. Electrometric method: pH 2. Colorimetric method 3. Spectroscopy method, Standardization & calibration of monitoring instruments.	7

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1313

Subject Name: Environmental Monitoring

3	Air Quality Monitoring Type of Air Quality monitoring - Ambient Air Quality monitoring, Source Air Quality monitoring, Ambient Air Quality Monitoring- Selection of monitoring sites, Sampling time, Frequency & mode of sampling, Source Air Quality Monitoring – Type of Monitoring procedure	7
SECTION-B		
4	Physical, Chemical and Microbial contaminants Physical contaminants – Naturally occurring particulates, Human made particulates, Mechanisms and control of particulate, Chemical contaminant: - Type of contaminants, Sources of Contaminants, contaminant transport and fate, Microbial contaminants: - Environmentally transmitted pathogens, concept of indicator organisms, sample processing and storage	8
5	Surface Water Monitoring: - Water Quality parameters, sampling the waters, Water sampling equipment,	5
6	Ground Water Monitoring: - Objectives, Location of monitor wells, well construction, Design and Execution of ground water sampling programs	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	20	10	05	05

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

Recommended Books:

1. Environmental monitoring and characterization by Janick F Artiola, Ian L Pepper, Mark Brusseau
2. Environmental Chemistry by Sawyer & McCarty

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1313

Subject Name: Environmental Monitoring

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Recognize the concept of environmental monitoring
CO-2	Classify various waste quality monitoring equipment
CO-3	Illustrate air quality monitoring program
CO-4	Examine various physical, chemical and microbial properties of contaminants
CO-5	Explain surface waste monitoring program
CO-6	Summarize ground waste monitoring program

List of Open-Source Software/learning website:

- NPTEL

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1314

Subject Name: Environmental Legislation & Audit

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Program Elective 4

Prerequisite: Students shall have basic knowledge of legislation.

Rationale: To provide knowledge related to various environmental protection laws, Acts, Rules and Notifications etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Historical And Constitutional Perspectives: Discuss Historical Perspective of Environmental protection, State Constitutional guarantees to environmental protection, Discuss National and International environmental policies.	05
2	Legislation for Water and Air Pollution: Familiarization with important sections and clauses of Water (Prevention & Control of Pollution) Act; 1974, Water Cess Act; 1977, Air (Prevention & Control of Pollution) Act; 1981	08
3	Environmental Protection Act, 1986: Familiarization with important sections and clauses of act, Improvement over previous acts, limitations	05
SECTION-B		
4	Waste Management Rules (As amended at the beginning of semester): Solid Waste Management Rules (SWM), 2016, Hazardous & other wastes (Management & trans boundary movement) Rules, 2016, Management and Handling rules for bio medical waste.	08

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Bachelor of Engineering

Subject Code: EV1314

Subject Name: Environmental Legislation & Audit

5	Miscellaneous Regulations (As amended at the beginning of semester): The Noise Pollution (Regulation & Control) Rules, 2000 & its amendments, The Public Liability & Insurance Act; 1991 & amendments, Public Interest Litigation Act; 1991; CRZ notification, Wildlife Protection Act, Government & MOEF Environmental Policy.	06
6	Environmental Audit: Definitions, objectives and benefits. Audit procedures: Pre audit activities; activities of site and post audit activities Environmental Audit Scheme as implemented by GPCB under the instructions of Hon. Gujarat High Court.	07

Suggested Specification table with Marks (Theory):

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

Recommended Books:

1. Environmental Legislation in India by K. R. Gupta, Encyclopedia of Environment.
2. Environmental Law by Dharmendra S. Sengar
3. Environment and pollution Laws containing Acts & Rules, S.K Mohanty
4. Publications/ Website of MoEFCC/ CPCB on Environmental Regulations
5. Environmental Law and Policy in India by Armin Rozencaranz; Shyam Divan and Marhta L. Noble; Tripathi Publications ISO 14000
6. Water (Prevention & Control of Pollution) Act; 1974 & its amendments 1978; 1988.
7. Air (Prevention & Control of Pollution) Act; 1981 & its amendments.
8. Environmental Protection Act; 1986 & its amendments.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1314
Subject Name: Environmental Legislation & Audit

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Relate different Constitutional provision for Environmental Protection.
CO-2	Identify major Acts and Rules for preventing and controlling the pollution.
CO-3	Assess the importance of Environmental Protection Act.
CO-4	Analyze various waste management rule.
CO-5	Summarize role of National Green Tribunal in Environmental Protection
CO-6	Carry out environmental audit of the industries as per the requirement of current environmental laws.

List of Open-Source Software/learning website:

- NPTEL
- Website of GPCB, MoEF, CC & CPCB.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering
Subject Code: EV1315
Subject Name: Chemical Engineering Process

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Open Elective 3

Prerequisite: Basic knowledge of inorganic and organic 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 C	Examination Marks				Total Marks
L	T	P		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 and Mechanisms of unit processes Introduction to unit processes. 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, e.g. hydrogenation of nitrobenzene, reductive alkylation reactions of anilines, Oxidation, e.g. oxidation of xylenes.	05
2	Chlor-alkali Industry Indian chemical industry - an overview. Manufacture of Chlor-Alkali chemicals: Products chart from Chlor-Alkali Industries. Manufacturing of Caustic Soda and Chlorine by membrane cell, mercury & diaphragm process, Manufacturing of Sodium Bicarbonate.	07
3	Sulphur Industry Introduction to Sulphur Industries. Different sources of Sulphur and Mining of Sulphur. Manufacture of Sulphuric Acid. Manufacture of sulphur trioxide, sodium sulphate, sodium thiosulphate.	07
SECTION-B		

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Bachelor of Engineering

Subject Code: EV1315

Subject Name: Chemical Engineering Process

4	Fertilizer Industry Overview of fertilizer manufacturing sectors in India. Nitrogen Industries: Manufacture of Nitric Acid. Manufacture of Urea and Diammonium Phosphate. Phosphorous industries: Manufacture of Phosphoric acid, Super phosphate and Triple super phosphate. Potassium industries: Manufacture of Potassium chloride and potassium sulphate.	07
5	Natural Product Industry Edible and essential oils Industries. Hydrogenation of oils. Manufacture of soaps and detergents. Pulp and Paper Industries: Introduction and Manufacture of Kraft Pulp, Paper. Manufacture of starch and sugar.	07
6	Synthetic Organic Chemicals Methane and synthesis gas. Steam reforming of naphtha. Manufacture of ethylene dichloride and vinyl chloride. Manufacture of Methanol and Formaldehyde.	06

Suggested Specification table with Marks (Theory):

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

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

Recommended Books:

1. Dryden, C. E. "Outlines of Chemical Technology" (Edited and Revised by M. Gopala Rao and M. Sittig) East West Press. Pvt. Ltd, New Delhi, 3 rd Edition (1997).
2. Austin G. T. Shreve's "Chemical Process Industries", 5th Edition, McGraw Hill (1984).
3. B K. Sharma, "Industrial Chemistry (Including Chemical Engineering)" Krishna Publishing House.
4. James A Kent, "Riegel's Handbook of Industrial Chemistry" Springer Publication.
4. A H Patel, "Industrial Microbiology" Trinity Press, Laxmi Publication Pvt Ltd.
5. M Gopala Rao, Marshall Sittig, "Outlines of Chemical Technology" Affiliated East West Press (Pvt) Ltd.
6. Encyclopedia of Industrial Chemistry, Ullmann, VCH, 1996.
7. Industrial Organic Chemistry, Weissmerl K & Arpe H.J., Weinheim, 1978.
8. Pandey G.N., "A Text Book of Chemical Technology", Volume 1 and 2, Vikas Publications
11. B. S. Mitchell.

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Bachelor of Engineering

Subject Code: EV1315

Subject Name: Chemical Engineering Process

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify and classify fundamental understanding of the process carried out in chemical industry.
CO-2	Discuss the basic reaction steps involved in the manufacture of various grades of chlor-alkali products.
CO-3	Develop process flow diagrams for various unit processes in Sulphur industry.
CO-4	Analyze all possible unit operations and processes in fertilizer plants.
CO-5	Summarize the practical importance and relevance of various unit processes taking place in the synthesis of natural products.
CO-6	Interpret the important unit operations and processes in the manufacture of synthetic organic chemicals.

List of Open-Source Software/learning website:

- NPTEL

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - VI

Type of course: Open Elective 3

Prerequisite: A good understanding regarding different physical modes of heat transfer is needed for a deep understanding in this subject. Mathematical background is also essential in this respect

Rationale: Heat transfer is a necessary process in virtually all forms of energy generation and use; from coal fired to nuclear power stations, from automobile engines to rocket motors, from refrigerating cold stores to air conditioning space vehicles. This subject is intended to make students aware about mechanisms involved in heat transfer process in many of aforementioned applications. This ultimately will enable the students to design the equipments for heat process viz., shell and tube heat exchangers, evaporators, condensers.

Teaching and Examination Scheme:

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

L-Lectures; T-Tutorial/Teacher Guided Student Activity; P-Practical; C-Credit; ESE-End Semester Examination; PA-Progressive Assessment

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Fundamentals of Heat Transfer & Conduction: Introduction, Engineering heat transfer and analogies between various transport processes, Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann law, Thermal conductance and resistance, Concept of heat conduction, Linear one-dimensional Heat conduction through wall, through cylinder and through sphere, Conduction through composite plane wall, conduction through composite cylinder, conduction through composite sphere, critical insulation thickness for pipes.	05
2	Heat Transfer by Convection: Heat transfer mechanism by convection, Thermal Boundary layer, Different dimensionless numbers in Convection	08

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Bachelor of Engineering

Subject Code: EV1316

Subject Name: Basics of Heat Transfer

	and their significance, Correlations for estimating rate of heat transfer in forced and free convection (No derivation needed)	
3	Radiation: Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of Radiation, Emissive power of black body, Plank's distribution, Total emissive power, Stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law, radiation shields	06
SECTION-B		
4	Phase change heat Transfer: Boiling and regimes of pool boiling & Forced convection boiling, Condensation: Physical mechanisms, types of condensation, Factors affecting condensation	08
5	Heat Exchangers: Introduction to Heat exchangers, types of heat exchangers, Overall heat transfer coefficient, Fouling, Mean temperature difference, L.M.T.D. correction factors, Extended surfaces.	06
6	Evaporation Introduction to Evaporators, Types of Evaporators, Boiling point elevation, Economy & Capacity, Single Effect and Multieffect Evaporators, Method of feeding, Overall heat transfer coefficient in Evaporators, Numerical based on Single effect evaporators, Agitated thin film dryer, MVR evaporators	06

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)

Recommended Books:

1. Binay. K. Dutta, "Heat Transfer Principles and applications" Prentice Hall of India
2. Ozisik M. N, "Heat Transfer - A Basic Approach", McGraw-Hill.
3. Incropera F. P. and DeWitt D. P, "Introduction to Heat Transfer". John Wiley & Sons
4. Kern D Q, Process Heat Transfer, McGraw Hill Book Co. (1997)
5. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004
6. Rao Y.V.C, "Heat Transfer", University Press, India
7. Cengel A. Yunnus. "Heat Transfer – A Practical Approach", McGraw Hill.

(Established under Gujarat Private Universities Act, 2009)

Bachelor of Engineering

Subject Code: EV1316

Subject Name: Basics of Heat Transfer

8. Geankopolis C J, Transport Processes and Separation Process Principles, Prentice Hall of India, 4th Edition, Eastern Economy Edition (2004)
9. Ramesh K. Shah and Dušan P. Sekulic, Fundamentals of Heat Exchanger Design, John Wiley & Sons, Inc. 2003

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify different modes of heat transfer and understand basic mechanism of conduction.
CO-2	Explain heat transfer under different convective regimes.
CO-3	Predict extent of heat flow by radiation through grey, white and real surfaces.
CO-4	Analyze heat transfer through different types of heat exchangers used for various applications.
CO-5	Describe industrial applications and regimes involved in boiling and condensation.
CO-6	Categorize different types of evaporators with their performance evaluation and to analyze material and energy balance for evaporators.

List of Open-Source Software/learning website:

- NPTEL