Ref: UPL University/SRICT/BOS/EST/2021-22/01
Date: 15-03-2022

Proposed Teaching Scheme for Second Year Diploma in Environmental Engineering

Semester-III (Environmental 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 course	EV1201	Environmental Management - I	3	0	0	3	3	70	30	0	0	100
2	Program core course	EV1202	Air Pollution Control - I	3	0	2	5	4	70	30	20	30	150
3	Program core course	EV1203	Ground Water Contamination & Remediation	3	0	0	3	3	70	30	0	0	100
4	Program core course	EV1204	Chemistry for Environmental Engineers	3	1	0	4	4	70	30	0	0	100
5	Program core course	EV1205	Waste Water Treatment - I	3	0	2	5	4	70	30	20	30	150
6	Humanities	MH1201	Communication Skills in English	3	0	2	5	4	70	30	20	30	150
7	Internship	MH1203	In plant Training	0	0	0	0	1	0	0	50	0	50
8	Audit Course	MH1202	Essence of Indian Traditional Knowledge	1	0	0	1	0	0	0	20	30	50
	Total			**19**	**1**	**6**	**26**	**23**	**420**	**180**	**130**	**120**	**850**

Semester-IV (Environmental 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 course	EV1206	Water Supply & Municipal Engineering	3	0	0	3	3	70	30	0	0	100
2	Program core course	EV1207	Air Pollution Control -II	3	0	2	5	4	70	30	20	30	150
3	Program core course	EV1208	Solid Waste Management - I	3	0	2	5	4	70	30	20	30	150
4	Program core course	EV1209	Environmental Management - II	4	0	0	4	4	70	30	0	0	100
5	Program Elective 1	EV1210	Sustainable Development & Green Technology	4	0	0	4	4	70	30	0	0	100
6	Program Elective 1	EV1211	Fundamentals of Chemical Engineering	4	0	0	4	4	70	30	0	0	100
7	Open Elective 1	EV1212	Basics of Unit Operations	2	0	2	4	3	70	30	20	30	150
8	Open Elective 1	EV1213	Environmental Bio Technology	3	0	0	3	3	70	30	0	0	100
	Total			**19**	**0**	**6**	**25**	**22**	**420**	**180**	**60**	**90**	**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

Diploma in Engineering
Subject Code: EV1201
Subject Name: Environmental Management-I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - III

Type of course: Program Core

Prerequisite: Students should have basic knowledge of basics of Environmental Management

Rationale: To provide knowledge related to different aspects of Environmental Management

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	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Environment: Definition, components of Environment, Interaction between different components of Environment, Impact of Human on Environment, Impact of Technological Development on Environment, Concept of Environmental Degradation, Recent developments from ministry in the field of environment.	**06**
2	Ecology: Definition, Objectives and Classification Ecosystem: Definition, Structure of Ecosystem and Function of Ecosystem. Food Chain: Definition and Introduction Food Web: Definition and Introduction	**07**
3	Water Resources: Introduction, Sources of Water, Water Resources of India, Distribution of Water Resources of India, Definition of Ground Water and Surface Water, Uses of Water and Requirements of Water	**07**
	SECTION-B	
4	Bioremediation: Definition, Introduction, Concept of Bioremediation, Types of Bioremediation, Application of Bioremediation in wastewater	**07**

Diploma in Engineering
Subject Code: EV1201
Subject Name: Environmental Management-I

	treatment. Introduction to Biotechnology, Types of Biotechnology, Applications of Biotechnology in Industries and Environmental Engineering	
5	Energy Resources: Introduction: Forms of Energy, Heat Energy, Power, Sun: The primary source of Energy, Energy Resources: Non Renewable Energy Resources, Renewable Energy Resources, Wind park, Solar Park.	**07**
6	Land and Soil Pollution, Degradation and Management Description of Lithosphere, Land Resources, Land Pollution. Sources and Health Consequences of Land Pollution, Efforts to reduce land pollution	**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	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)

Recommended Books:

1. Environment, 6th Revised Edition, by Shankar IAS Academy, Book Publications
2. Environmental Science, B.R. Shah, Dr. Snehal Popli, Mahajan Publishing House
3. Environmental Studies, third edition, from crisis to cure by R.Rajgopalan
4. Environmental Science-Systems & Solutions, J.B.Pub. Intl by Michael L. Mckinney & Robert M.Schoch
5. Handbook of Bioremediation Edited by Norris et al, Robert S. Kerr;
6. Bioremediation Principles: Ewies, Ergas, Chang and Schroeder

Diploma in Engineering
Subject Code: EV1201
Subject Name: Environmental Management-I

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Examine the concept of Ecology and Ecosystem
CO-2	Discuss water resources
CO-3	Discover Land and Soil Pollution, Degradation and Management
CO-4	Analyse the application of Energy Resources
CO-5	Interpret Bioremediation
CO-6	Organize components of Environment

List of Open-Source Software/learning website:

- NPTEL
- Coursera.org

Diploma Engineering
Subject Code: EV1202
Subject Name: Air Pollution Control – I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - III

Type of course: Program Core

Prerequisite: Students shall have basic understanding of air pollution along with some basic information of pollutant dispersion.

Rationale: This subject is intended to make students aware about the noise and air pollution, degradation of air quality through various sources of air pollution, assessment of air quality through air quality index, and various air pollution control methods and equipment.

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	**Introduction to Air Pollution:** Air and its composition, Air Pollution, Sources of air pollution and its classification, Major air Pollutants and their characteristics, Effects of air pollution on human health and vegetation, animals and materials, Major air pollution episodes.	**08**
2	**Meteorology and Air Pollution:** Introduction to meteorology, basics of Temperature lapse rate and stability, basic of adiabatic lapse rate, Atmospheric stability, Inversion, wind velocity and turbulence, plume behavior.	**08**
3	**Air Pollution Sampling and Measurement:** Ambient Air Sampling and Analysis of air pollutants: SO_2, NOx, PM_{10}, $PM_{2.5}$, Introduction to Stack Sampling, Fugitive emissions, odor control.	**08**

Diploma Engineering
Subject Code: EV1202
Subject Name: Air Pollution Control – I

SECTION-B		
4	**Air Pollution Laws and Standards:** Salient features of Air pollution Control Act and rules 1981, NAAQS	**05**
5	**Air Quality** Indoor Air quality: Sources, health effects, controls. Air Quality index: categories, objectives.	**05**
6	**Introduction to noise:** Sound Pressure, Sound Pressure level (Decibel), Difference between sound and noise, Pitch and Frequency, sources of noise and harmful effects of noise, noise measurement and noise control measures.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	15	05	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 Pollution Control and Engineering, Rao C.S., New Age International (P) Limited, 3rd Ed., 2018.
2. Air Pollution, Perkin, H.G. McGraw Hill 1974.
3. Air Pollution – by Wark & Warner
4. Air Pollution. Physical and Chemical Fundamentals, Sainfeld, J.H. McGraw Hill, N.Y. 1975.
5. Air Pollution: Measurement, Modeling and Mitigation, A Tiwari and J Colls, Taylor & Francis, 2010
6. Sources and Control of Air Pollution, R J Heinsohn and R L Kabel, Prentice Hall, 1999

Diploma Engineering
Subject Code: EV1202
Subject Name: Air Pollution Control – I

7. Air Pollution Control Equipment Calulations, L Theodore, John Wiley and Sons, 2008

8. Catalytic Air Pollution Control, Hack, Furraoto and Gulati,John Wiley and Sons, 2009

List of Practical:

1. Determination of SPM in ambient air.
2. Determination of $PM_{2.5}$ in ambient air.
3. Determination of PM_{10} in ambient air.
4. Sampling of SO_2 in ambient air.
5. Analysis of SO_2 sampled in ambient air.
6. Demonstration of stack sampling for determination of Particulate Matter using stack monitoring kit.
7. Demonstration of handy air sampler.
8. Sampling of ammonia in ambient air.
9. Analysis of ammonia sampled in ambient air
10. Measurement of Noise using Sound Level meter

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Recall the concept of air pollution including its sources and effects.
CO-2	Interpret the impact of various meteorological parameters on air pollutants.
CO-3	Experiment sampling and analysis of various air pollutants.
CO-4	Outline the important features of air pollution laws and standards.
CO-5	Explain air quality standards and understand the quality of air using various indices.
CO-6	Revise the concept of noise pollution and implement its control measures.

List of Open-Source Software/learning website:

- NPTEL

Diploma in Engineering
Subject Code: EV1213
Subject Name: Environmental Biotechnology

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Open Elective - I

Prerequisite: None.

Rationale: To offer students understanding regarding the fundamental concepts of Environmental Biotechnology in all aspects of environment such as Environmental microbiology, production of value added products and biotechnological methods to control pollution.

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)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to Environmental Biotechnology:** Introduction to Environmental Biotechnology, characteristics and classification of microbes, role of microbes in environment (Bacteria, algae, fungi, protozoa, virus).	**10**
2	**Eukaryotes, Prokaryotes and Viruses:** Eukaryotes: Brief description about protozoa, algae and fungi and their role and importance in Environment, Prokaryotes and Viruses: Brief description about Bacteria and Viruses and their role and importance in Environment.	**08**
3	**Environmental Microbiology:** Microbiology of soil, air, water, Basic principal of microbial transformation of organic matter, biodegradation, acclimatization.	**08**
	SECTION-B	

Diploma in Engineering
Subject Code: EV1213
Subject Name: Environmental Biotechnology

4	**Basic Methods used in Microbiology:** Culture media, isolation and identification of microbes, culture technique, Pure & mixed culture, Aerobic and anaerobic metabolism, microbial growth.	**08**
5	**Biotechnological methods to control pollution:** Role of microorganism in water and waste water engineering, Microbiology applied to air/water pollution control (Bioremediation, Bioscrubbers and biofilter) Biogas technology- production.	**10**
6	**Production of value added products from waste using Biotechnology:** Ethanol, Methane, Biodegradable plastics , Microbial composting - Biofertilizers- Biopesticides, Applications of biotechnology in Industries and environmental engineering	**08**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	15	20	0	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. Microbiology by, Pelczar 5th Edition.
2. Biotechnology by B.D. Singh
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House)
4. Introduction to Microbiology by A.S. Rao Environmental Microbiology by Ralph Mitchell
5. Handbook of Bioremediation Edited by Norris et al, Robert S. Kerr; Environmental Research Laboratory

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	**CO statement**
CO-1	Recognize the role and importance of microbes in natural environment.
CO-2	Differentiate between Eukaryotes, Prokaryotes and Viruses.
CO-3	Interpret the Environmental Microbiology of various elements of the environment.

Diploma in Engineering
Subject Code: EV1213
Subject Name: Environmental Biotechnology

CO-4	Analyze the basic Methods used in Microbiology.
CO-5	Develop the concept of Biotechnological methods to control pollution.
CO-6	Appraise the production of value added products.

List of Open-Source Software/learning website:

- NPTEL
- Coursera.in

Diploma in Engineering
Subject Code: EV1203
Subject Name: Ground water Contamination & Remediation

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - III

Type of course: Program Core

Prerequisite: Fundamental Knowledge of ground water contamination and their preventive measures.

Rationale: Students shall have basic knowledge of Ground water contamination.

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)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Definition of ground water, vertical distribution of subsurface water, ground water in hydrologic cycle, ground water investigation, ground water level fluctuations & environmental influence.	07
2	**Occurrence and Hydraulics of Ground Water:** Occurrence of the ground water, Geological factors governing the occurrence of ground water, Zones of Under-ground water, Movement of groundwater and its velocity, Darcy's Law, its range of validity	07
3	**Sources of Ground water pollution:** Sources that are at (i) Ground Level, (ii) Below Ground Level but above Water Table (iii) Below Water Table and Causes of ground water pollution, Aquifers and its types.	06
	SECTION-B	
4	**Ground water Quality and its Analysis:** Physical /chemical /biological analysis of ground water quality, criteria & measures of ground water quality, ground water salinity, Indian and international standards	07

Diploma in Engineering
Subject Code: EV1203
Subject Name: Ground water Contamination & Remediation

5	**Ground water remediation:** Source control strategies, Types of treatment technologies, In situ treatment methods, Pump and treat method, Carbon adsorption method, Introduction of bioremediation **Ground water conservation:** Ground water balance, ground water budget, seepage from surface water, artificial recharge, Remote sensing application to ground water.	**07**
6	**Soil Contamination and Remediation:** Definition of soil pollution, soil pollution due to natural and biological factor, Soil contamination and chemical and biological remediation techniques	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	15	10	05	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 Engineering by Gerard Kiely
2. Water Supply Engineering by S. K. Garg
3. Ground water hydrology and contamination by Nicholas Cheremenisoff
4. Ground Water by Raghunath
5. Ground Water Hydrology: By D K Todd
6. Groundwater Resources Education by W C Walton
7. Remote sensing applications to groundwater by A.M.J. Meijerink

Diploma in Engineering
Subject Code: EV1203
Subject Name: Ground water Contamination & Remediation

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify the sources of ground water contamination.
CO-2	Differentiate the Indian and international water standards for different purposes.
CO-3	Employ the ground water survey work to check the quantity and quality of ground water.
CO-4	Outline the remedial and preventive measures to overcome ground water contamination.
CO-5	Explain the laws of ground water hydraulics for different types of aquifers.
CO-6	Decide the mechanisms for ground water conservation.

Diploma in Engineering
Subject Code: EV1204
Subject Name: Chemistry for Environmental Engineers

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - III

Type of course: Program core course

Prerequisite: Students should have basic knowledge of Environmental Chemistry.

Rationale: This course contains the topics and sub topics which will be useful for them in different ways like selection of chemicals and processes to have comfort, Fresh water and Air and life style. To know the chemical parameters and their environmental significance, the subject will help in the real world.

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	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Contaminants and their natural pathways of degradation and their abatement: Carbon Cycle, Nitrogen Cycle, Sulphur Cycle, CO formation in atmosphere, Photochemical Smog, Ozone chemistry and Acid rain	**05**
2	Gas Laws: Boyle's Law, Charle's Law, Generalized Gas Law, Dalton's Law, Henry's Law, Graham's Law, Gay-Lussac's Law, Ideal gas characteristics. Thermodynamics: Heat and work, Energy enthalpy, free energy, basic concept of surface tension, adsorption, solvent extraction, chemical kinetics, enzyme reaction and Three laws of thermodynamics. Electrochemistry: Current flow in solution, conductivity, electrochemical cell and electrolytic cell	**07**
3	Concept of % W/W, &W/V, PPM, PPB, Primary & secondary standards, Volumetric and Gravimetric analysis, Types of titration and indicators. Buffer, p H concept, Kw, Ka, Kb, Ksp concept, Basic understanding of vapor pressure, equilibrium, ionization, common ion effect, activity coefficient and amphoteric Hydroxides	**07**

Diploma in Engineering
Subject Code: EV1204
Subject Name: Chemistry for Environmental Engineers

SECTION-B		
4	Classification of elements, Periodic table, Concept of hybridization, SPD orbitals and shape, Hydrogen bond, Heavy metals and there effect in environment, Methods of preparation of distilled water.	**07**
5	Basic unit process for benzene and its homologues with one example, Hydrocarbons, O,M,P directory groups, Basic understanding about Inductive effect, Electromeric effect, Resonance and hyper conjugation, Environmental implication and basics of phenol, alcohol, aldehyde, ketone, acid, nitro compounds and heterocyclic compounds.	**07**
6	Basic concept of sampling, precipitation, filtration, drying, desiccation, analytical balance and its operation, basic introduction of optical methods of analysis and electrical methods of analysis.	**06**

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)

Recommended Books:

1. Environmental Chemistry by B.K. Sharma S.H. Kaur Goel Publishing House, Meerut,1992.
2. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press LLC,2001
3. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L.Strong Chemistry of the Environment, Elsevier Science & Technology Books 2002
4. Environmental Chemistry, A.K.De.,New Age Intl. pub Co,New Delhi, 1990
5. Chemistry for Environmental Engineering, C.N.Sawyer and P L Mc Carty, Mc Graw Hill ltd.,
6. Environmental Chemistry - G.S. Sodhi

Diploma in Engineering
Subject Code: EV1204
Subject Name: Chemistry for Environmental Engineers

List of Tutorials:

1. Contaminants and their natural pathways of degradation and their abatement.
2. Ozone chemistry and Acid rain
3. Gas Laws
4. Basics of Thermodynamics
5. Electrochemistry
6. Volumetric and Gravimetric analysis
7. Classification of elements, Periodic table, Concept of hybridization, SPD orbitals and shape
8. Basic understanding about Inductive effect, Electromeric effect, Resonance and hyper conjugation
9. Basic concept of sampling
10. Basic introduction of optical methods of analysis and electrical methods of analysis.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Define the uses and importance of instruments.
CO-2	Understand the importance of general chemistry
CO-3	Apply knowledge of preparing standard solution
CO-4	Interpret the method of cleaning laboratory wares and calibration of laboratory wares
CO-5	Choose appropriate technique for analyzing water and wastewater parameters
CO-6	Summarize quantitative & qualitative analysis

List of Open-Source Software/learning website:

Diploma in Engineering
Subject Code: EV1204
Subject Name: Chemistry for Environmental Engineers

- NPTEL
- Coursera.org

Diploma in Engineering
Subject Code: EV1205
Subject Name: Wastewater Treatment - I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - III

Type of course: Program Core

Prerequisite: Basics of Water Pollution

Rationale: The main objective of this subject is to make students aware about designing aspects of preliminary and primary treatment units along with sludge handling and tertiary treatment of wastewater.

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Wastewater Engineering: Terminology, Fundamentals of wastewater treatment, types of wastewater, wastewater treatment methods, Sources of water pollution, common impurities in water, standards for wastewater discharge, water borne diseases, Health & Environmental concerns in wastewater management.	**07**
2	Constituents in wastewater: Wastewater constituents, Characteristics of wastewater: Physical, Chemical & Biological, Components of wastewater flow, domestic wastewater and industrial wastewater, analysis of wastewater flow rates	**07**
3	Sources and classification of water pollutants: Water resources, utilization of water, origin of wastewater, wastewater composition, types of water pollutants and is effects.	**05**
	SECTION-B	

Diploma in Engineering
Subject Code: EV1205
Subject Name: Wastewater Treatment - I

4	Sampling & preservation of wastewater samples (Objective, Selection of sample containers, Selection of type of sampling, Selection of sampling points, Selection of type of filling the container, In – situ measurements, Sample labeling, Collection and preservation of samples for organics and trace metals, Sampling and Handling Requirements). Introduction to Sewage Treatment plant and Effluent Treatment Plant.	**07**
5	Wastewater management & stream segregation, Domestic Wastewater and industrial wastewater, Introduction to different environmental sink for the disposal of wastewater, strength reduction & volume reduction.	**07**
6	Wastewater Analysis: Sampling, methods of analysis, determination of organic matter: Dissolved oxygen, Biochemical Oxygen demand, Chemical oxygen demand, Total organic carbon. Determination of inorganic substance: Nitrogen, Phosphorus, Alkalinity, Acidity, Bioassay Test, Heavy metals estimation.	**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

Diploma in Engineering
Subject Code: EV1205
Subject Name: Wastewater Treatment - I

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.
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 Practical:

1. To determine pH of wastewater sample.
2. To determine Alkalinity of wastewater sample.
3. To determine Acidity of wastewater sample.
4. To determine Turbidity of wastewater sample.
5. To determine Conductivity of wastewater sample.
6. To determine Total Suspended Solids of wastewater sample.
7. To determine Chlorides of wastewater sample.
8. To determine Residual Chlorine of wastewater sample.
9. To determine Sulphates of wastewater sample.
10. To determine Total Dissolved Solids of wastewater sample.

Diploma in Engineering
Subject Code: EV1205
Subject Name: Wastewater Treatment - I

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the basic concepts of wastewater engineering.
CO-2	Identify the characteristics of wastewater.
CO-3	Recollect the sources of water and pollutants present in water.
CO-4	Outline the purpose of sampling and preservation of samples.
CO-5	Differentiate between domestic and industrial wastewater.
CO-6	Determine the sampling methods for wastewater analysis.

(Established under Gujarat Private Universities Act, 2009)

Diploma of 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 of 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**

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 of 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 of 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: EV1206
Subject Name: Water Supply & Municipal Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Core

Prerequisite: Knowledge of hydrological cycle and its components

Rationale: To understand the water supply and sewage collection systems in cities

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	Necessity of water supply schemes, salient features of water supply scheme, flow chart of water supply scheme, duties of water works engineer, planning and execution of water supply scheme.	**07**
2	Water Demand: Introduction, types of water demand, factors affecting the rate of demand, per capita demand, break up of domestic and public demand, variations of water demand, population forecasting.	**07**
3	Sources of water, terms related to underground sources, hydrological cycle, precipitation, types of precipitation, various form of ground water & surface water, sub surface water.	**06**
	SECTION-B	
4	Introduction to sanitary engineering, methods of collection, merits and demerits of conservancy system, water carriage system.	**05**

Diploma in Engineering
Subject Code: EV1206
Subject Name: Water Supply & Municipal Engineering

5	Quantity of storm water, factors affecting quantity of storm water, determination of intensities of rainfall, the rational method, run off coefficient, empirical method.	**07**
6	Sewer appurtenances: manhole, drop manhole, lamp holes, flushing tanks. Sewage pumping & disposal: types of pumping station, location of pumping station, requirement of sewage pumps, power required for pumping, methods of disposal, dilution standards for polluted waters, self-purification, disposal in sea water, land treatment.	**07**

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. G.S. Birdie - "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company.
2. B.C. Punamia - "Water Supply Engineering", Laxmi Publication New Delhi.
3. S.K. Garg- "Water Supply Engineering".

Course Outcomes: After learning this course, students will be able to:

Sr. No.	**CO statement**
CO-1	Understand the components of water supply scheme.
CO-2	Evaluate the water demand considering the future population growth.
CO-3	Recognize the various sources of water.
CO-4	Recollect the basics of sanitary engineering.
CO-5	Estimate the quantity of storm sewage.
CO-6	Identify the types of sewer and sewer appurtenances.

Diploma in Engineering
Subject Code: EV1207
Subject Name: Air Pollution Control – II

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Core

Prerequisite: Students shall have basic understanding of air pollution along with some basic information of pollutant dispersion.

Rationale: This subject is intended to make students aware about the noise and air pollution, degradation of air quality through various sources of air pollution, assessment of air quality through air quality index, and various air pollution control methods and equipment.

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	**Introduction to Air Pollution Control:** Mechanisms to control gaseous pollutants: wet removal by precipitation, chemical reaction in the atmosphere to produce aerosols and absorption of aerosols. Mechanisms to control particulate matter: Wet removal by precipitation, Dry removal by sedimentation.	**04**
2	**Air Pollution control methods and equipment:** Introduction to control methods and equipment for Particulate matter and gases. Construction and working of scrubbers, Electrostatic Precipitator, Gravity settlers, Cyclone separator, Filter bags etc.	**08**

Diploma in Engineering
Subject Code: EV1207
Subject Name: Air Pollution Control – II

3	**Control of Specific Gaseous Emissions:** Control of SO_2: extraction from fuel, sulphur reduction during combustion, desulphurization, Processes using metal oxides and activated carbon, wet scrubbing. Control of NO_x: modification of operating condition, modification of design condition, treatment of effluent gas	**08**
SECTION-B		
4	**Air Quality Modeling:** Introduction to air quality modelling, deterministic models, statistical models, physical models, Introduction to dispersion modelling, photochemical modelling, receptor modelling.	**07**
5	Plume rise theory & equation, Stack Height, Effective Stack Height, Introduction to maximum mixing depth, Ventilation Coefficient, Wind Rose diagram & applications, Various air dispersion models.	**06**
6	**Automobile Emission & Control:** Sources of automobile air pollution, A/F ratio theory, factors affecting emissions, determination Control of exhaust gas emissions by fuel change, engine design change external reactors.	**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 Pollution Control and Engineering, Rao C.S., New Age International (P) Limited, 2nd Ed., 2006.
2. Air Pollution, Perkin, H.G. McGraw Hill 1974.
3. Air Pollution – by Wark & Warner
4. Air Pollution. Physical and Chemical Fundamentals, Sainfeld, J.H. McGraw Hill, N.Y. 1975.

Diploma in Engineering
Subject Code: EV1207
Subject Name: Air Pollution Control – II

5. Air Pollution: Measurement, Modeling and Mitigation, A Tiwari and J Colls, Taylor & Francis, 2010
6. Sources and Control of Air Pollution, R J Heinsohn and R L Kabel, Prentice Hall, 1999
7. Air Pollution Control Equipment Calulations, L Theodore, John Wiley and Sons, 2008
8. Catalytic Air Pollution Control, Hack, Furraoto and Gulati, John Wiley and Sons, 2009

List of Practical:

1. Plot wind rose for a given location using given data.
2. Sampling of NO_x in ambient air.
3. Analysis of NO_x sampled in ambient air.
4. Study the working of Gravity Settling Chamber and conceptualize pollutant removal efficiency.
5. Demonstrate the working of Cyclone separator.
6. Demonstrate the working of ESP.
7. Demonstrate the working of Bag Filter.
8. Demonstrate the working of Adsorption Tower.
9. Demonstrate the working of Absorption Tower.
10. Study practical on calculation of A/F ratio of methane and petrol.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Recognize various mechanisms for control of gaseous and particulate pollutants.
CO-2	Discuss various methods and equipment for control of air pollution.
CO-3	Develop an understanding regarding control of specific gaseous pollutant.
CO-4	Compare and contrast various air quality models.
CO-5	Explain the gaussian plume modeling for determination of air pollutant

Diploma in Engineering
Subject Code: EV1207
Subject Name: Air Pollution Control – II

	dispersion.
CO-6	Summarize the concept of automobile air pollution and implement its control measures.

List of Open-Source Software/learning website:

- NPTEL

Diploma in Engineering
Subject Code: EV1208
Subject Name: Solid Waste Management - I

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Core

Prerequisite: Students shall have basic idea regarding the evolution of waste, its handling, processing, and separation and disposal options.

Rationale: To know the types, current challenges and future scope of solid waste generation.

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	**Evolution of Solid Waste Management:** Definition of Solid waste; Solid Waste- A consequence of life; Material flow and waste generation, Functional elements of a waste management system; Impacts of solid waste on environment.	**06**
2	**Sources, Composition and Types of Municipal Solid Waste:** Sources of solid waste; Classification of solid wastes; Importance of classification; Composition of solid waste; Future changes in waste composition- Impacts of waste diversion programs.	**07**
3	**Properties of MSW and types of Hazardous waste found in MSW::** Physical properties of MSW; Chemical properties of MSW; Biological properties of MSW. Properties and Classification of hazardous waste; Sources, Types and Quantity of hazardous waste found in MSW.	**07**
	SECTION-B	

Diploma in Engineering
Subject Code: EV1208
Subject Name: Solid Waste Management - I

4	**Municipal Solid Waste (Generation and Collection):** Solid waste generation and Collection rate: Importance of waste quantities; Solid waste generation and collection rate; Factors affecting waste generation. Onsite handling; Onsite storage & Onsite processing of solid waste. Collection of solid waste: Waste collection concept; Terminologies; Collection equipments.	**07**
5	**Municipal Solid Waste (Transportation and Disposal):** Separation and Processing and Transformation of solid waste: Basic concept; Material Recovery Facility. Transfer and Transport: Concept; Means of transport; Transfer station and its requirements. Disposal of Solid waste: Landfill concept of solid waste disposal; Terminologies; Types of landfill.	**07**
6	**Plastic Waste Management:** Terminologies of plastic waste; Composition of Plastics; Plastic waste management; Current scenario of plastic waste in India.	**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	15	10	10	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. Solid & Hazardous waste Management by PM Cherry.
2. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management", the McGraw- Hill, New York, 3rd Ed., 1993.
3. M.S. Bhatt, "Solid Waste Management-An Indian Perspective", 2020.
4. Environmental Engineering by B.R Shah and A.M Malek.
5. Kiely G., "Environmental Engineering", McGraw Hill Book Company, 1998.
6. Rao C.S., "Environmental Pollution Control and Engineering", New Age International (P) Limited, 1991.

7. Manual on Municipal Solid waste management by Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

List of Practicals:

1. To determine the moisture content in given solid waste sample.
2. To demonstrate biomedical waste model.
3. To analyze the collection of municipal solid waste sample.
4. To determine the pH of a given sample of solid waste by pH meter.
5. To determine the pH of a given sample of solid waste by using Universal pH indicator.
6. To carry out Paint Filter Liquid Test (PFLT) for a given sample of solid waste to check the availability free moisture content.
7. To determine Loss on ignition (% organic matter) of given sample of solid waste.
8. To design a solid waste transfer station.
9. To develop the solid waste management system for a smart city.
10. To demonstrate sanitary landfill model.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the basic terminologies of solid waste, its functional elements and future scope.
CO-2	Identify various sources, types and composition of solid waste.
CO-3	Explain the basic properties of solid waste and the hazardous waste portion found in MSW.
CO-4	Amplify the various generation, separation and collection routes of MSW.
CO-5	Describe the transportation and disposal options available for dumping solid waste.
CO-6	Illustrate the concept of plastic waste management in India.

List of Open-Source Software/learning website:

- NPTEL

Diploma in Engineering
Subject Code: EV1209
Subject Name: Environmental Management-II

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Core

Prerequisite: Students should have basic knowledge of basics of Environmental Management

Rationale: To provide knowledge related to different aspects of Environmental Management

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)	
4	0	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Fundamentals of GIS and RS: Remote Sensing: Definition, Objectives and Application, Recent trends in RS and Environmental assessment & monitoring. GIS: Definitions and Terminology, GIS categories, Levels/scales of Measurement, GIS in EIA (Topography Sheet).	**08**
2	Life Cycle Assessment: Definition, Objectives, Practical use of LCA in Environmental Labelling.	**08**
3	Current Environmental Issues and Case Studies: Deterioration of Taj Mahal, Construction of Tehri dam, Ganga Pollution, Bhopal Gas Leak Disaster, Minamata Tragedy, Oleum Gas Leak, Environmental Consideration in Rural Development, Environmental Friendly Approaches for Generation of Energy, Landfill Issue of Ghaziabad, Bangalore Lake Fire.	**10**
	SECTION-B	
4	Carbon Credit: Definition, Introduction, Concept of Carbon Credit	**08**

Diploma in Engineering
Subject Code: EV1209
Subject Name: Environmental Management-II

	Carbon Footprint: Definition, Introduction, Effects and Application of Carbon Footprint.	
5	Biodiversity: Concept and its Importance, Keystone Species in Conservation Strategy, Measuring Biodiversity, Present Scenario and Status of Biodiversity Conservation in India.	**08**
6	National and International Efforts at Environment Protection: The 42nd Constitutional Amendment, National Committee on Environment Planning ,Other national efforts in the direction of Environmental Protection, UN Conference on Human Environment1972, Environmental Education Conference, Montreal Protocol, Climate or Green House control convention, Concept and Significance of Paris Agreement, The Rio Summit Follow up, Sustainable Development in India :Perspectives and Strategies.	**10**

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)

Recommended Books:

1. Environmental Management by S.K. Agarwal
2. Environmental Engineering and Management by Dr. Suresh K. Dhameja
3. Environmental Engineering by Gerard Kiley
4. Fundamental Geographic Information Systems-Demers 1995 edition
5. Textbook of Remote Sensing and GIS, M. Anji Reddy, B.S. Publications
6. Environmental Management, National and Global Perspectives by Swapan C. Deb
7. Environmental Engineering and Management by Dr. Suresh k. Dhameja

Diploma in Engineering
Subject Code: EV1209
Subject Name: Environmental Management-II

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Examine the concept of Fundamentals of GIS & Remote Sensing
CO-2	Discuss Life Cycle Analysis
CO-3	Discover importance of Current Environmental Issues and Case Studies
CO-4	Analyze Significance of Carbon Credit
CO-5	Interpret importance of Environmental Treaties
CO-6	Organize Biodiversity

List of Open-Source Software/learning website:

- NPTEL
- Coursera.org

Diploma in Engineering
Subject Code: EV1210
Subject Name: Sustainable Development and Green Technology

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Elective 1

Prerequisite: Students should have basic knowledge of Sustainable Development.

Rationale: To have an increased awareness among students on issues in areas of sustainability. To understand the role of engineering and technology within sustainable development.

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)	
4	0	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Concept of sustainable development, Sustainable development Goals: Indian & Global Scenario, Elements of sustainable development, Sustainable habitat, Sustainable Urbanization, Economy of Natural resources, Principles of sustainable developments, Introduction to ESG.	**08**
2	Industrial ecology and Green Productivity, GP methodology, Green building, Introduction to ISO 14001, Conventional and renewable sources, Zero waste concept, Need for renewable energy and Growth of renewable energy in India.	**08**
3	Introduction to green chemistry, Principles of green chemistry, Basics of solvent free systems, super critical fluids, ionic liquids, microwave reactions and sonochemical reactions.	**10**
	SECTION-B	

Diploma in Engineering
Subject Code: EV1210
Subject Name: Sustainable Development and Green Technology

4	Cleaner Production Methodology Six steps methodology for CP, Analyze process steps, generating cleaner production opportunities, selecting cleaner production solutions, Implementation, maintaining cleaner production, CP Tools, Benefits of CP	**10**
5	Need for Cleaner Production, Barriers and drivers to Cleaner Production, Introduction and implementation of good housekeeping, Check lists for good housekeeping and need to implement good housekeeping.	**08**
6	Case study of CP: Co-processing of Hazardous and Non Hazardous Wastes as Alternate Fuel in Cement Kiln, Creation of Wealth from High TDS Waste Stream through "Waste Recovery Plant", Co-processing of Pharmaceutical Waste in Cement Kiln.	**08**

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)

Recommended Books:

1. Allen.D.T and Shonnard, D.R Sustainability Engineering: Concepts, Design and case studies, Prentice Hall.
2. Bhattacharya R.N, (2002).Environmental Economics. Oxford University Press
3. Bhattacharya, S.C.(2011).Energy Economics, Springer, London
4. Agrawal, A N (1995). Indian Economy: Problems of development and planning. pune: Vishwa Prakashan.
5. Bradely.A.S: Adebayo,A.O. Maria,P. Engineering applications in sustainable design and development, Cengage learning

6. Environment impact assessment guidelines, Notification of government of India, 2006

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO-2	Explain the different types of environmental pollution problems and their sustainable solutions
CO-3	Discuss the environmental regulations and standard
CO-4	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles
CO-5	Outline the concepts related to conventional and non-conventional energy
CO-6	Identify the role of engineering and technology within sustainable development

List of Open-Source Software/learning website:

- NPTEL
- Coursera.org

Diploma in Engineering
Subject Code: EV1211
Subject Name: Fundamentals of Chemical Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Program Elective - I

Prerequisite: Fundamental knowledge of basic science subjects (Physics and Chemistry) along with Mathematics.

Rationale: The main objective of this subject is to make students aware of process operations carried out in industries involving Unit operations and process. Transport process used in Chemical Engineering Operations along with methods of expressing concentration of solutions and mixtures are also necessary. Awareness regarding safe working practices essential for eliminating accidents are also emphasized.

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)	
4	0	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Chemistry & Chemical Engineering:** Evolution of Chemical Engineering, Relationship between Chemistry and Chemical Engineering; Chemical Kinetics – Rate data, Differences between Kinetics & Thermodynamics, Reactors – Classification (Batch, semi-batch and continuous reactor systems), MFR and PFR.	**08**
2	**Safety in Chemical Laboratory:** Hazards, Hazards symbols (Bio-Hazard, Toxic, Corrosive, Flammable), Safety standard Instructions; Types of Accidents – Trivial, Minor and Major cause of accidents in laboratories, Personal protective equipments – Apron, splash goggles, Face shield, Helmet, Ear plug, Ear muff, Hand gloves, thermal gloves; First aid measure – Eye Injury, burns, accidental ingestion, skin contact, inhalation of toxic fumes	**08**

Diploma in Engineering
Subject Code: EV1211
Subject Name: Fundamentals of Chemical Engineering

3	**Concepts in Chemical calculations:** Concepts of Atomic weight, equivalent weight and mole. Composition of Solids, Liquids and Solutions (weight percent, mole percent, molarity, normality 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	**10**
SECTION-B		
4	**Unit operations & Unit Process:** Definition and classification of Unit Operations and Unit process, Basic Mechanical operations – Size separation and size reduction, Filtration, Sedimentation, Magnetic separation. PID Symbols of unit operations, Unit Process - Definition and Applications – Oxidation, Reduction, Sulphonation, Nitration, Hydrogenation, Dehydrogenation, Dehydration, Esterification.	**08**
5	**Transport operations –** Momentum Transfer, Fluid properties, Density, Specific gravity, specific volume, Specific weight, Pressure, Viscosity, Newton's law of viscosity, Pressure – Pressure measurement & its scales. Heat Transfer – Mechanisms of Heat Transfer, Conduction, Convection, Radiation (Basic laws and problems governing rate of heat transfer), Significance of specific heat and latent heat capacities. Evaporation. Mass transfer – Diffusion, Introduction to Distillation, Leaching, Drying, Absorption, Adsorption	**10**
6	**Fuels & Heat effects:** Types of fuels, calorific value of fuels, gaseous fuel, Proximate and ultimate analysis, Heat effects accompanying chemical reactions, Hess's law, Heat of reaction at constant pressure and volume.	**08**

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)

Recommended Books:

1. W.L.Mc.Cabe, J.C.Smith and P.Harriot, "Unit operations of Chemical Engineering", McGraw Hill International edition VII.

Diploma in Engineering
Subject Code: EV1211
Subject Name: Fundamentals of Chemical Engineering

2. Ghoshal S.K, Sanyal Shyamal K, Dutta S, Introduction to Chemical Engineering, Tata Mc Graw Hill Publications.
3. Walter L Badger, Julius T Banchero, Unit operations of Chemical Engineering", McGraw Hill International edition
4. Dr. Mistry K U, Fundamentals of Industrial Safety and Health, Siddharth Prakashan, Ahmedabad
5. Binay. K. Dutta, "Heat Transfer Principles and applications" Prentice Hall of India.
6. Binay. K. Dutta, "Principles of Mass Transfer and Separation Process" Prentice Hall of India.
7. Stoichiometry & Process Calculations, Narayanan K.V., &Lakshmikutti B., Prentice Hall, 2006
8. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Identify the importance of reaction rate for designing reactors used in industries for process operations.
CO-2	Explain the safety concepts in Chemical laboratory through usage of personal protective equipments and implementation of first aid measures.
CO-3	Apply the concept of moles for expressing composition of solids, liquids and gases.
CO-4	Differentiate unit operations and unit process carried out in Industry for transformation of raw materials into finished products.
CO-5	Describe various transport operations in momentum heat and mass transfer fronts in Industrial Operations.
CO-6	Relate fuel quality with type of fuel for understanding heat requirement of feedstock in different chemical reactions.

List of Open-Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding regarding various unit operations.

Diploma in Engineering
Subject Code: EV1212
Subject Name: Basics of Unit Operations

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Open Elective - I

Prerequisite: Basic knowledge of unit and dimension, theoretical knowledge of mass fraction, mole fraction, material balance.

Rationale: The objective of this course is to study various unit operations used in effluent treatment involving solid-solid and solid-liquid handling, mixing and separation.

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	**Particulate Solids**: Characterization of solid particles, particle shape, particle size, specific surface of mixture, average particle size, screen analysis: standard screen series. Screening and screening equipment: stationary screens and grizzlies, vibrating screens.	**04**
2	**Size Reduction:** Principles of comminution, energy and power requirements in comminution, crushing efficiency, empirical relationships: Rittinger's and Kick's laws. Bond's crushing law and work index. Types of size-reduction equipment. Crushers: jaw crushers. Grinders: hammer mills and ball mills. Open-circuit and closed circuit operation.	**05**
3	**Separations based on motion of particles through Fluid:** Gravity settling processes. Batch sedimentation, various sedimentation zones, rate of sedimentation. Equipment for sedimentation: thickeners and clarifiers.	**04**

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SECTION-B		
4	**Filtration:** Introduction, principles and mechanisms of filtration. Filter media and filter aids. Mechanism and working principle of some filters: plate and frame filter press and rotary drum filter. Bag filters. Application of filtration in wastewater treatment.	**05**
5	**Centrifugal Separations:** Introduction and principle of centrifugal separations. Separation of liquids in a centrifuge: tubular bowl centrifuge. Working principle and mechanism of cyclones and hydrocyclones.	**04**
6	**Agitation and Mixing:** Principles of agitation, agitation equipment, flow patterns: prevention of swirling, baffles and draft tubes.	**04**

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. Roy G. K. "Mechanical Operations". Khanna Publications (2018).
3. Foust A. S. & associates, "Principles of Unit Operations" John Wiley and Sons (1980).
4. McCabe Smith, "Unit Operation in Chemical Engineering" 5th ed. McGraw Hill (1985).
5. Perry R.H. & Chilton C.H., "Chemical Engineers Hand Book", 7th ed. McGraw hill.
6. Badger and Bencharo, "Introduction to Chemical Engineering". Tata McGraw hill.

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7. S. K. Gupta, "Momentum Transfer Operation". Tata McGraw Hill (1979)
8. Davidson J.F. &Harrison D."Fluidization" Academic press (1985)
9. Kunni & Levenspiel "Fluidization engineering "Wiley (1962)
10. Brown, G.G. and associates, "Unit operations" Wiley, New York, (1950).
11. Coulson and Richardson: Chemical Engineering, Vol. 2.Butterworth Heinemann Pub
12. Welty, Wicks, Wilson & Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th ed. Wiley,
13. Narayanan C.M. & Bhattacharya B.C. "Mechanical Operations for Chemical engineers", Khanna Publishers. 3rd Ed.1999.

List of Practical:

1. Determination of average particle size of the given mixture by sieve analysis.

2. To study the working principle and mechanism of a Jaw Crusher.

3. To determine the average particle size of the given mixture of particles using Jaw Crusher.

4. To study the working principle and mechanism of a Roll Crusher.

5. To determine the average particle size of the given mixture of particles using Roll Crusher.

6. To study the working principle and mechanism of a Ball Mill.

7. To determine the average particle size of the given mixture of particles using Ball Mill.

8. To study the various zones of sedimentation of dilute calcium carbonate slurry.

9. To study the characteristic settling curve of sedimentation of dilute calcium carbonate slurry.

10. To study the working principle and mechanism of cyclone separator.

Course Outcomes:

Diploma in Engineering
Subject Code: EV1212
Subject Name: Basics of Unit Operations

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Define and enumerate properties of solid and solid mixtures
CO-2	Classify and discuss size reduction and screening equipment with their applications
CO-3	Develop and illustrate the principles of filtration and its application in environmental science and technology
CO-4	Analyze and categorize sedimentation and centrifugal separation equipment with their application in treating waste
CO-5	Summarize different solid – fluid and solid – solid separation equipment
CO-6	Interpret and evaluate the applications of all unit operation equipment in the field of environmental science and technology

List of Open-Source Software/learning website:

- NPTEL

Diploma in Engineering
Subject Code: EV1213
Subject Name: Environmental Biotechnology

Shroff S.R. Rotary Institute of Chemical Technology

Semester: - IV

Type of course: Open Elective - I

Prerequisite: None.

Rationale: To offer students understanding regarding the fundamental concepts of Environmental Biotechnology in all aspects of environment such as Environmental microbiology, production of value added products and biotechnological methods to control 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	**Introduction to Environmental Biotechnology:** Introduction to Environmental Biotechnology, characteristics and classification of microbes, role of microbes in environment (Bacteria, algae, fungi, protozoa, virus).	**10**
2	**Eukaryotes, Prokaryotes and Viruses:** Eukaryotes: Brief description about protozoa, algae and fungi and their role and importance in Environment, Prokaryotes and Viruses: Brief description about Bacteria and Viruses and their role and importance in Environment.	**08**
3	**Environmental Microbiology:** Microbiology of soil, air, water, Basic principal of microbial transformation of organic matter, biodegradation, acclimatization.	**08**
	SECTION-B	

Diploma in Engineering
Subject Code: EV1213
Subject Name: Environmental Biotechnology

4	**Basic Methods used in Microbiology:** Culture media, isolation and identification of microbes, culture technique, Pure & mixed culture, Aerobic and anaerobic metabolism, microbial growth.	**08**
5	**Biotechnological methods to control pollution:** Role of microorganism in water and waste water engineering, Microbiology applied to air/water pollution control (Bioremediation, Bioscrubbers and biofilter) Biogas technology- production.	**10**
6	**Production of value added products from waste using Biotechnology:** Ethanol, Methane, Biodegradable plastics , Microbial composting - Biofertilizers- Biopesticides, Applications of biotechnology in Industries and environmental engineering	**08**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	15	20	0	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. Microbiology by, Pelczar 5th Edition.
2. Biotechnology by B.D. Singh
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House)
4. Introduction to Microbiology by A.S. Rao Environmental Microbiology by Ralph Mitchell
5. Handbook of Bioremediation Edited by Norris et al, Robert S. Kerr; Environmental Research Laboratory

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	**CO statement**
CO-1	Recognize the role and importance of microbes in natural environment.
CO-2	Differentiate between Eukaryotes, Prokaryotes and Viruses.
CO-3	Interpret the Environmental Microbiology of various elements of the environment.

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Subject Name: Environmental Biotechnology

CO-4	Analyze the basic Methods used in Microbiology.
CO-5	Develop the concept of Biotechnological methods to control pollution.
CO-6	Appraise the production of value added products.

List of Open-Source Software/learning website:

- NPTEL
- Coursera.in