UPL UNIVERSITY
OF
SUSTAINABLE TECHNOLOGY

Evaluation Reforms NEP 2020

2nd Year Bachelor of Engineering

Environmental Science & Technology

Shroff S R Rotary Institute of Chemical Technology,

Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

Teaching Scheme for
Second Year Bachelor of Environmental Science & Technology

Semester-III (Environmental Science & Technology) Structure

Sub Code	Course	Teaching Scheme (hrs. / week)			Total	Credit	Examination Scheme				
		L	T	P	Hr.	C	SEE	CCE	I/TW	V	Total
BEVBS311	Mathematics for Environmental Engineers	3	1	0	4	4	50	50	25	25	150
BEVPC301	Environmental Chemistry & Microbiology	3	0	2	5	4	50	50	25	25	150
BEVPC302	Environmental Management	3	1	0	4	4	50	50	25	25	150
BEVPC303	Wastewater Treatment - I	3	0	2	5	4	50	50	25	25	150
BUNAE321	English Proficiency Course	2	0	2	4	3	50	50	25	25	150
BUNVA331	Yoga for Well-Being	0	0	4	4	2	0	0	25	25	50
	Total	**14**	**2**	**10**	**26**	**21**	**250**	**250**	**150**	**150**	**800**

Semester-IV (Environmental Science & Technology) Structure

Sub Code	Course	Teaching Scheme (hrs. / week)			Total	Credit	Examination Scheme				
		L	T	P	Hr.	C	SEE	CCE	I/TW	V	Total
BEVPC401	Process Calculations	3	1	0	4	4	50	50	25	25	150
BEVPC402	Advanced Instrumentation Techniques	3	1	0	4	4	50	50	25	25	150
BEVPC403	Wastewater Treatment - II	3	0	2	5	4	50	50	25	25	150
BEVVS404	Green Technology Lab	0	0	2	2	1	0	0	25	25	50
BEVPE405/ BEVPE406	Waste Valorization/Environmental Risk Management	3	0	0	3	3	50	50	0	0	100
BUNVA431	Universal Human Values	2	0	0	2	2	50	50	0	0	100
BXXOE441	Open Elective - 1	2	0	0	2	2	50	50	0	0	100
Total		**16**	**2**	**4**	**22**	**20**	**300**	**300**	**100**	**100**	**800**
BEXXD451	Multidisciplinary Minor Course-1	3	1	0	4	4	50	50	25	25	150

L	Lecture	SEE	Semester End Examination
T	Tutorial	CCE	Continuous and Comprehensive Examination
P	Practical	I	Internal
C	Credit	TW	Term Work
		V	Viva

Open Elective - I (Semester – IV)
(Open Electives for Environmental Science & Technology Students)

Sr.	Course Code	Course	Offered by (Department)
1	BCOOE441	Emerging Technologies	Computer Engineering
2	BCTOE441	Materials Engineering	Chemical Technology
3	BEEOE441	Fundamentals of Renewable Energy Technologies	Electrical Engineering
4	BCHOE441	Introduction to Chemical Industry	Chemical Engineering
5	BMEOE441	Basics of Maintenance Engineering	Mechanical Engineering
6	BITOE441	IT for Sustainability	Information Technology

**Detailed syllabus separately available*

MDC - I (Semester – IV)
Multidisciplinary Minor Course (MDC-1) for Environmental Science & Technology Students

Sr.	Course code	MDC-1 (Semester-4)	Minors	Offered by
1	BMEMD451	Boiler and Steam Utility Systems	Mechanical Aspects of Process Utilities	Mechanical Engineering Department
2	BCHMD451	Introduction to Industrial Safety	Industrial Safety	Chemical Engineering Department
3	BCOMD451	Fundamentals of Data Science	Data Science	Department of Computer Engineering
4	BITMD451	Fundamentals of Cloud and Virtualization	Cloud computing	Department of Information Technology
5	BEEMD451	Basics of Measuring Instruments	Industrial Instrumentation and Automation	Department of Electrical Engineering
6	BPRMD451	Fundamentals of Pharmaceutical Engineering	Pharmaceutical Engineering	Department of Chemical Technology (Pharmaceutical Technology)
7	BGCMD451	Fundamentals of Materials Science and Engineering	Ceramics Engineering	Department of Chemical Technology (Glass & Ceramics Technology)

8	BDPMD451	Introduction to Paint and Coating Technology	Paint Technology	Department of Chemical Technology (Dyes & Pigments Technology)
9	BPRMD451	Chemistry of Polymers	Polymer Science and Engineering	Department of Chemical Technology (Polymer & Rubber Technology)

**Detailed syllabus separately available*

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Mathematics for Environmental Engineers (BEVBS311)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

COURSE OVERVIEW:

- To apply the numerical and statistical methods in problem solving attitude in the field of Environmental Engineering.
- The numerical methods give the solution of applied problems when ordinary analytical methods fail.
- The students should gain ability which enables them to select the appropriate numerical technique to solve a given engineering problem.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Approximations and Errors:** Types of Errors, Significant Figures, Accuracy of Numbers, Precision, Error Propagation, Applications in Environmental Engineering.	1	07
2	**Solution of Algebraic and Transcendental Equations:** Basic Properties of Equations, Relations between Roots and Coefficients, Descartes Rule of Sign, Synthetic Division of a Polynomial by a Linear Expression, Bracketing Methods (Bisection, Secant, Method of False Position or Regula Falsi, etc.)	2	07
3	**Curve Fitting** Method of Least Squares, Fitting a straight line and a polynomial, Fitting a Non-linear Function, Fitting Geometric and Exponential Curves, Fitting a Hyperbola, a Trigonometric Function, etc.	3	08
	SECTION-B		
4	**Finite Differences & Interpolation:** Finite Differences: Forward, Backward and Divided Differences Table, Central Differences, Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Inverse Interpolation	4	08
5	**Numerical Differentiation & Integration:** Differentiation Formula based on Tabulator at Equal and Unequal Intervals, Newton-Cotes Integration Formulas, Trapezoidal Rule and Simpson's 1/3 and 3/8 Rule	5	07
6	**Ordinary Differential Equations:** Euler's Method, Modifications and Improvements in Euler's Method,	6	08

	Runge-Kutta 2nd Order & 4th Order Methods, Milne's Predictor-Corrector Methods, Boundary Value Problems		

LIST OF TUTORIALS

1. Tutorial-1 Approximation, Accuracy (Significant Figures and Precision)
2. Tutorial-2 Error Analysis (Types of Errors and Propagation in Environmental Engineering)
3. Tutorial-3 Algebraic Equations (Properties, Roots, and Synthetic Division)
4. Tutorial-4 Transcendental Equations (Bracketing Methods: Bisection, Secant, and Regula Falsi)
5. Tutorial-5 Curve Fitting (Least Squares, Polynomials, and Non-Linear Functions)
6. Tutorial-6 Finite Differences (Forward, Backward, and Divided Difference Tables)
7. Tutorial-7 Interpolation (Newton's Formulas, Lagrange, and Inverse Interpolation)
8. Tutorial-8 Numerical Differentiation (Formulas for Equal and Unequal Intervals)
9. Tutorial-9 Numerical Integration (Newton-Cotes, Trapezoidal, and Simpson's Rules)
10. Tutorial-10 Ordinary Differential Equations (Euler, Runge-Kutta, and Predictor-Corrector Methods)

TEXT BOOKS:

1. S C Chapra and R P Canale, Numerical Methods for Engineers, McGraw Hill International Edition.
2. John H Mathews, Numerical Methods for mathematics & science, 2nd Edition, Prentice Hall.
3. Pushpavanam S, Mathematical Methods in Chemical Engineering, Prentice Hall of India.

REFERENCE BOOKS:

1. N W Loney, Apllied Mathematical Methods for Chemical Engineers, CRC Press.
2. R G Rice, D D Do, Applied Mathematics and Modeling for Chemical Engineers, Wiley.
3. V G Jenson, G V Jeffreys, Mathematical Methods in Chemical Engineering, Elsevier.

ONLINE RESOURCES:

- https://archive.nptel.ac.in/courses/127/105/127105018/
- https://archive.nptel.ac.in/courses/127/106/127106004/

COURSE OUTCOMES:

After learning this course, Students will be able to:

CO1	**Define** the concepts of approximation and error.
CO2	**Explain** various algebraic and transcendental equations.
CO3	**Apply** various numerical methods for curve fitting.
CO4	**Classify** various finite differences and interpolation methods.
CO5	**Evaluate** the application of various numerical differentiation and integration methods in the field of Environmental Engineering.
CO6	**Solve** applicative methods of ordinary differential equations.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Environmental Chemistry & Microbiology (BEVPC301)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	2	5	4	50	50	25	25	150

COURSE OVERVIEW:

This course provides a comprehensive foundation and understanding of environmental chemistry and microbiology, covering principles of volumetric and gravimetric analysis, water chemistry, air pollution chemistry, and soil chemistry along with bio-geochemical cycles, and emphasizes understanding of analytical techniques for environmental monitoring, including sampling methods and the analysis of key physicochemical parameters in water, air, and soil systems, while also developing understanding of environmental microbiology fundamentals, microbial classification, laboratory techniques, and the role of microorganisms in environmental processes, pollution control, wastewater treatment, and microbial applications in bioremediation, including in-situ and ex-situ treatment of soil, groundwater, and wastewater, along with an introduction to biotechnology and innovative environmental treatment approaches.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Volumetric and Gravimetric Analysis:** Sampling methods, Concept and applications of Quantitative analysis: Precipitation, filtration, Drying, Desiccation, Concept and applications of Volumetric analysis in engineering field	1	5
2	**Water Chemistry & Analysis:** Concept and analysis of: pH, turbidity, acidity, alkalinity, chloride, DO, BOD, COD, residual chlorine, and heavy metals, Water Quality Standards: Drinking water standards , Aquatic biochemical processes	2	6
3	**Air Pollution Chemistry:** Earth's radiation balance, particles ions, and radicals in atmosphere, Chemical and photochemical reactions in the atmosphere: oxygen and ozone chemistry and depletion, sluphur dioxide, nitrogen dioxide, organic compounds, acid rain chemistry, Greenhouse gases	3	6
	SECTION-B		
4	**Soil Chemistry & Bio-geochemical Cycles:** Composition of lithosphere, soil, water and air in soil, inorganic and organic composition in soil, acid-base and ion-exchange reactions in soil, micronutrients and macronutrients, nitrogen pathways and NPK in soil, wastes and pollution in soil, Heavy metal mobility in soils, Bio-geochemical Cycles: Hydrological Cycle, Carbon Cycle, Nitrogen	4	6

	Cycle, Sulphur Cycle and phosphorus cycle.		
5	**Environmental Microbiology Fundamentals and Techniques:** Scope of microbiology in environmental engineering, Structure and classification of microbes, Role of microbes in human life and environment, Prokaryotic cell, Brief description about Bacteria and Viruses and their role and importance in Environment, Eukaryotes, Brief description about protozoa, algae and fungi and their role and importance in Environment. Optical microscopes and electron microscopes, staining techniques, Culture methods in microbiology: Techniques of sterilization, Media preparation, Isolation and inoculation, direct observation, pure culture and mix cultures and its importance, Maintenance, and preservation of cultures	5	11
6	**Microbial Applications and Bioremediation:** Principles of control of microbes, uses of physical agents and chemical agents. Role of microbes in human diseases and their control - Diseases caused by bacteria, Diseases caused by virus. Microbes involved and their role wastewater treatment: bacteria, fungi, algae, protozoa, rotifers and crustaceans. Introduction to Biortechnology, Fundamental principles, In-situ bioremediation of soil and Groundwater, Ex-situ bioremediation of soil, Wastewater bioremediation, Innovative treatment technologies, Case studies. Introduction to Biotechnology.	6	11

LIST OF PRACTICAL:

1. To determine the pH of soil samples for evaluating their suitability for agricultural applications and waste disposal practices.
2. To measure the electrical conductivity (EC) of a given water sample and interpret the results in accordance with Bureau of Indian Standards (BIS) drinking water guidelines.
3. To determine the total dissolved solids (TDS) content of a water sample and assess its quality based on BIS drinking water standards.
4. To estimate the alkalinity of a water sample and interpret the results as per BIS drinking water limits.
5. To develop proficiency in the handling and operation of an optical microscope for the observation and identification of microorganisms in environmental samples.
6. To demonstrate the ubiquitous nature of microorganisms in different environmental conditions.
7. To determine the Most Probable Number (MPN) of microorganisms in a given water sample.
8. To perform the Standard Plate Count (SPC) using the serial dilution technique for quantification of microbial load.
9. To carry out Gram staining of bacterial cultures for classification of microorganisms relevant to wastewater treatment processes.
10. To conduct a composting experiment to study microbial degradation of organic waste and evaluate its application in solid waste management.

TEXT BOOKS:

1. Environmental Chemistry by A.K. De, 7th Edition, New Age International (P) Ltd.
2. Chemistry for Environmental Engineering by Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin, 5th Edition, McGraw-Hill.
3. Microbiology by Pelczar, Chan and Krieg, 5th Edition, McGraw-Hill.

4. Environmental Microbiology by Ralph Mitchell and Ji-Dong Gu, 3rd Edition, Wiley-Blackwell.
5. Wastewater Engineering: Treatment and Reuse by Metcalf & Eddy Inc., revised by George Tchobanoglous, Burton and Stensel, 4th Edition, McGraw-Hill.
6. Quantitative Analysis by R.A. Day Jr. and A.L. Underwood, 6th Edition, Pearson Education.
7. Introduction to Microbiology by A.S. Rao, latest edition, CBS Publishers/Prentice Hall India.
8. Textbook of Environmental Microbiology by Pradipta K. Mohapatra, 1st Edition, I.K. International Publishing House.

REFERENCE BOOKS:

1. Standard Methods for the Examination of Water and Wastewater by American Public Health Association, American Water Works Association and Water Environment Federation, 23rd Edition, American Public Health Association.
2. Environmental Microbiology by Manish L. Shrivastava, latest edition, CBS Publishers & Distributors.
3. Environmental Microbiology by Banwarilal, latest edition, CBS Publishers & Distributors.
4. Handbook of Bioremediation edited by Norris et al., Robert S. Kerr Environmental Research Laboratory, 1st Edition, CRC Press.
5. Bioremediation Principles by Eweis, Ergas, Chang and Schroeder, 1st Edition, McGraw-Hill.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/102105087
- https://nptel.ac.in/courses/102103015
- https://nptel.ac.in/courses/105107173

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	**Apply** quantitative analytical techniques to determine environmental parameters using volumetric and gravimetric methods.
CO 2	**Analyze** physicochemical parameters of water such as pH, turbidity, alkalinity, DO, BOD, COD, and heavy metals, and evaluate water quality.
CO 3	**Examine** atmospheric chemical processes and differentiate the effects of various air pollutants on the environment.
CO 4	**Analyze** soil characteristics and relate biogeochemical cycles to nutrient dynamics and pollutant behaviour.
CO 5	**Demonstrate** microbiological techniques to identify and characterize microorganisms in environmental samples.
CO 6	**Evaluate** and design suitable microbial-based treatment and bioremediation strategies for environmental management.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Environmental Management (BEVPC302)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

COURSE OVERVIEW:

- This course introduces the fundamental principles of environmental management, focusing on the structure and functioning of ecosystems, natural resource management, and environmental sustainability.
- It provides foundational knowledge on environmental issues and management approaches necessary for environmental engineers to develop sustainable solutions for resource conservation and pollution prevention.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Introduction to Environmental Management**: Definition, scope, and importance of environment, Environmental science vs environmental engineering. Concept and principles of environmental management, Role of environmental engineers in sustainable development.	1	07
2	**Ecosystem and Ecological Processes:** Concept, structure, and functions of ecosystem, Types of ecosystems (terrestrial and aquatic) Energy flow in ecosystem, Food chain, food web, and trophic levels Ecological pyramids, Artificial Ecosystems	2	08
3	**Natural Resources and Their Management**: Classification of natural resources, Water resources and sustainable management Forest resources and conservation, Land resources and soil conservation, Watershed Management, Wasteland Development and Role of National Wastelands Development Board (NWDB)	3	07
	SECTION-B		
4	**Biodiversity and Environmental Conservation**: Concept and types of biodiversity, Importance of biodiversity, Threats to biodiversity, Biodiversity conservation strategies, In-situ and ex-situ conservation National parks, wildlife sanctuaries, and biosphere reserves.	4	07
5	**Bioremediation**: A promising Technology for Pollution Cleanup Importance of Bioremediation, Needs, Merits and Scope of Bioremediation, Approaches to Bioremediation, Ecology of Bioremediation, Technology of Bioremediation, Phytoremediation: Concept and Importance, Field Scale Applications of Phytoremediation.	5	08

6	**Environmental Issues and Case Studies**: Increasing Sea Level, Polyethylene: An Environmental Disaster, Lead Pollution and its Control, Pesticide Pollution and its control, Santa Babara Oil Slick, 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	6	08

LIST OF TUTORIAL:

1. Introduction to Environmental Management
2. Ecosystem Concept, Structure and Functions
3. Types of Ecosystems (Terrestrial and Aquatic)
4. Energy Flow in Ecosystem, Food Chain, Food Web and Trophic Levels
5. Ecological Pyramids and Biogeochemical Cycles
6. Natural Resources and Their Management
7. Water Resources, Forest Conservation, Land Resources and Watershed Management
8. Biodiversity and Environmental Conservation
9. Bioremediation, Phytoremediation and Environmental Biotechnology
10. Environmental Issues and Case Studies

TEXT BOOKS:

1. J. Glynn Henry and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall, 1996, ISBN: 978-0133981322.
2. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 3rd Edition, Pearson Education, 2007, ISBN: 978-0137848584.
3. A. K. De, Environmental Chemistry, 6th Edition, New Age International Publishers, 2001 (reprint), ISBN: 978-8122412482.
4. Gerard Kiely, Environmental Engineering, 1st Edition, McGraw-Hill, 1997, ISBN: 978-0071164245.
5. R. C. Gaur, Basic Environmental Engineering, 2nd Edition, New Age International Publishers, 2008, ISBN: 978-8122426366.

REFERENCE BOOKS:

1. Benny Joseph, Environmental Studies, 2nd Edition, Tata McGraw-Hill Education, 2009, ISBN: 978-0070151345.
2. C. S. Rao, Environmental Pollution Control Engineering, 2nd Edition, New Age International Publishers, 2006, ISBN: 978-8122418354.
3. P. Venugopala Rao, Principles of Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2006, ISBN: 978-8120329331.
4. Stanley E. Manahan, Environmental Chemistry, 9th Edition, CRC Press, 2010, ISBN: 978-1439884034.
5. William P. Cunningham and Mary Ann Cunningham, Environmental Science: A Global Concern, 14th Edition, McGraw-Hill Education, 2015, ISBN: 978-0073383293.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/102106069

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	**Explain** the fundamental concepts of environment and environmental management.
CO 2	**Describe** ecosystem structure, ecological processes, and energy flow in nature.
CO 3	**Analyze** the utilization and conservation of natural resources.
CO 4	**Evaluate** environmental issues related to biodiversity loss and ecological imbalance.
CO 5	**Determine** Significance of Biotechnology and Bioremediation
CO 6	**Interpret** different and current environmental issues

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Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Wastewater Treatment - I (BEVPC303)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	2	5	4	50	50	25	25	150

COURSE OVERVIEW:

- To understand wastewater characteristics (physical, chemical, biological) and analyze flow variations and key quality parameters.
- To apply sampling methods and preliminary treatment techniques (screening, grit removal, equalization, oil & grease removal) and evaluate their effectiveness in STP and ETP systems.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Introduction to wastewater treatment:** Wastewater Constituents, Characteristics of wastewater: Physical, chemical, biological. Sources of water & generation of wastewater. Standard wastewater discharge limits as prescribed by competent authority. Drinking water standards.	1	07
2	**Analysis and selection of wastewater flow rates:** Components of wastewater flows, Wastewater Sources and flowrates: Domestic, Residential areas, Commercial areas, Institutional, Recreational facilities, Variations in wastewater flow rate: Diurnal variations, Seasonal Variations, Industrial Variations.	2	07
3	**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.	3	08
	SECTION-B		
4	**Preliminary Treatment of wastewater- Screening & Equalization** **Screening:** Classification of Screens, Hand cleaned screens, mechanically cleaned screens, Purpose, Head loss in screens, Screenings handling, processing & disposal. **Flow Equalization:** Concept, Description of flow equalization, Design Considerations, Location of equalization facilities, In line and	4	08

	Off line equalization, Strength & Flow Equalization, Determination of capacity of equalization tank.		
5	**Preliminary Treatment of wastewater - Grit Chamber** **Grit Chamber:** Concept, Grit Removal, Types of Grit chamber: Rectangular horizontal flow, Aerated grit chamber, Vortex type grit chamber, Grit characteristics, Grit Quantities, Grit Processing, Grit Disposal. Oil & grease removal, Dissolved air flotation.	5	07
6	**Primary Treatment of wastewater:** **Coagulation**: Coagulation tank, feeding devices for coagulation, mixing device of coagulants, types of coagulants, dry feeding and wet feeding of coagulants. **Mixing and Flocculation**: Continuous rapid mixing in wastewater treatment, Continuous mixing in wastewater treatment, Flocculation in wastewater treatment, Energy dissipation in mixing and flocculation. **Primary Sedimentation**: Description, Rectangular tanks, Circular Tanks, Types of settling, Functions of Primary sedimentation tanks.	6	08

LIST OF PRACTICAL:

1. To determine Acidity of wastewater sample
2. To determine alkalinity of wastewater sample
3. To determine Turbidity of wastewater sample
4. To determine total dissolved solids of wastewater sample
5. To determine total suspended solids of wastewater sample
6. To determine Ammonical Nitrogen 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 iron of wastewater sample

TEXT 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.

REFERENCE BOOKS:

1. Industrial Water Pollution Control, Eckenfelder W.W.; McGraw Hill Book Company, 3rd Ed, 2000.
2. Environmental Engineering, Kiely G.; McGraw Hill Book Company, 1998.
3. Pollution control in process industries, S.P. Mahajan TMH., 1985.
4. Waste water treatment, M.Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.
5. Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.

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

ONLINE RESOURCES:

- https://archive.nptel.ac.in/courses/127/105/127105018/
- https://archive.nptel.ac.in/courses/127/106/127106004/

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	**Explain** wastewater characteristics, sources, and standards for discharge and drinking water quality.
CO 2	**Analyze** wastewater flow components and variations from different sources for effective system design.
CO 3	**Differentiate** appropriate sampling and preservation techniques for accurate wastewater analysis in STP and ETP.
CO 4	**Demonstrate** the working and design considerations of preliminary treatment processes such as screening and flow equalization.
CO 5	**Analyze** the design and functioning of grit chambers, oil & grease removal, and dissolved air flotation systems.
CO 6	**Evaluate** coagulation, flocculation, and primary sedimentation processes for efficient wastewater treatment performance.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
English Proficiency Course (BUNAE321)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	2	4	3	50	50	25	25	150

COURSE OVERVIEW: 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.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (30)
	SECTION-A		
1	**Dynamics** of Communication: Definition and process Kinesics Proxemics Paralinguistic features Importance of Interpersonal and Intercultural Communication in today's organizations	1	6
2	Technical Writing: Report writing Technical proposal Technical description Business letters(sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter) Agenda of meeting, Minutes of meeting, Resume writing	2	4
3	**Technical Communication:** Public speaking, Group discussion, Presentation strategies, Interview skills, Negotiation skills ,Critical and Creative thinking in communication	3	5
	SECTION-B		
4	**Ethics in Engineering:** Scope of engineering ethics, Accepting and sharing responsibility , Resolving ethical dilemmas, Making moral choices	4	4
5	**Etiquettes**: Telephone etiquettes, Etiquettes for foreign business trips, Etiquettes for small talks, Respecting privacy, Learning to say NO, Time management.	5	5
6	**Self-development and Assessment:** Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream	6	6

LIST OF PRACTICALS AND TERM WORK (9 to 10 Experiments/TW)

1. Role Play
2. Letter Writing
3. Group Discussion
4. Presentation
5. Book Review (Preferably related to self- development)
6. Mock Interview

7. Report Writing
8. Case studies related to unit 4, 5 and 6
9. Conducting meeting with Agenda
10. Minutes of the Meeting

TEXT BOOKS:

1. Raman and Sharma, Technical Communications, OUP, New Delhi, 2017.

REFERENCE BOOKS:

2. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018.
3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014.
4. Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance, Pearson, UP, 2013.
5. Ramesh and Ramesh, the Ace of Soft Skills, Pearson, UP, 2019.
6. Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009.

ONLINE RESOURCES:

- https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases

COURSE OUTCOMES

CO1	**Define and describe** dynamics of verbal and non-verbal aspects of communication.
CO2	**Associate** with various formal documents of technical and professional communication.
CO3	**Interpret** communication of diverse formal situations taking place in organizations.
CO4	**Illustrate** and examine the knowledge of ethical aspects of engineering.
CO5	**Establish** and explain social and professional etiquettes.
CO6	**Recommend** self -development and self - assessment.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester III
Yoga for Well Being (BUNVA331)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		CEE	M	I	V	Total
0	0	4	4	2	00	00	25	25	50

COURSE OVERVIEW:

This course is designed to provide a comprehensive understanding of the principles and practices of Yoga for overall well-being. It integrates theoretical knowledge with practical training in Asanas, Pranayama, and Meditation to promote physical fitness, mental balance, and emotional stability. The course emphasizes the role of Yoga in preventing and managing lifestyle diseases, enhancing concentration, reducing stress, and developing a healthy daily routine. Through regular practice and conceptual learning, students will cultivate self-discipline, body awareness, and a holistic approach toward health and well-being.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (60)
1	**Yoga and Asana** • Meaning, Definition and Importance of Yoga • Meaning, Definition and Importance of Asana • Asanas for Prevention of Lifestyle Diseases	1	20
2	**Pranayama and Body Balance** • Meaning, Definition and Importance of Pranayama • Various Types of Pranayama • Importance of Pranayama for Balanced Body and Mind	2	20
3	**Yoga Meditation and Stress Management** • Meaning, Definition and Importance of Yoga Meditation • Basic Meditation Techniques • Stress Management through Yoga	3	20

LIST OF PRACTICALS AND TERM WORK (9 to 10 Experiments/TW)

1. Performance and viva of minimum 1-topic including explanation of benefits.
2. Demonstration of skills, techniques, and basic rules of any 5 selected Asana),
3. Any one of the Topic as specialization.
4. Asana Practical.

TEXT BOOKS

1. Yoga Education – NCERT (National Council of Educational Research and Training)
2. Common Yoga Protocol – Ministry of AYUSH, Government of India
3. Yoga for Healthy Living – Swami Ramdev / Baba Ramdev's Yoga Textbook

REFERENCE BOOKS

1. The Heart of Yoga – T.K.V. Desikachar

2. Yoga for Wellness – Yoga Journal Books
3. Light on Yoga – B.K.S. Iyengar
4. Yoga: Its Meaning, Theory and Practice – Swami Digambarji

ONLINE RESOURCES

- https://www.ayush.gov.in/
- https://svyasa.edu.in/
- https://www.artofliving.org/
- https://nimhans.ac.in/

COURSE OUTCOMES

CO1	**Understand** the fundamentals of Yoga, Asanas, Pranayama, and Meditation for holistic health and mental well-being.
CO2	**Develop** practical skills to perform Asanas and Pranayama with correct posture and breathing.
CO3	**Apply** yogic practices for improving fitness, managing stress, and preventing lifestyle-related diseases.
CO4	**Build** self-discipline through log-book and project work, and track personal health and fitness progress.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Process Calculations (BEVPC401)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

COURSE OVERVIEW:

- To familiarize the concept of various unit operations used in different industries for transforming raw materials into value added products taking into account of sustainable development goals.
- To learn, analyse and calculate mass, energy and composition of streams entering and leaving various unit operations and process.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Introduction:** Introduction to Unit Operations: Fluid flow operations, Heat transfer Operations, Mass Transfer Operations, Mechanical Operations Mixing, Introduction to Unit process. **Units, Dimensions:** Dimensions & system of units, Fundamental and derived units, Unit conversion and its significance.	1	08
2	**Basic Chemical Calculations:** Atomic weight, equivalent weight and mole. Composition of Solids, Liquids and Solutions, Average molecular weight and density, Composition of Gaseous mixtures, Applications of Ideal gas law, Real gas laws, Raoult's law, Henry's law, Amagat's law and Dalton's law	2	08
3	**Material Balances without Chemical Reactions:** Material balance on unit operations: Mixing, Drying, Evaporation, Crystallization, Distillation, Absorption, Adsorption etc. Unsteady state material balance.	3	09
	SECTION-B		
4	**Material balances with Chemical Reactions:** Concept of limiting and excess reactants, percentage conversion and yield. Material balance involving chemical reactions, Carbon emission factor.	4	09
5	**Combustion Calculations:** Types of fuels, Proximate & Ultimate analysis, calorific value, theoretical and excess air and oxygen requirement for combustion, composition of fuel and flue gases with Carbon footprint calculations.	5	05
6	**Energy Balances**: Forms of energy, heat capacity (C_p), Calculation of enthalpy change,	6	06

	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		

LIST OF TUTORIAL:

1. Tutorial 1: Units and Conversion in Process Calculations
2. Tutorial 2: Calculating the composition of Solid, liquid and gaseous mixtures
3. Tutorial 3: Estimation of thermodynamic properties of single and multicomponent solutions.
4. Tutorial 4: Material balance calculations in process units without considering chemical reactions.
5. Tutorial 5: Material balance calculations in Unsteady state process units.
6. Tutorial 6: Estimation of yield, selectivity and conversion in process involving chemical reactions.
7. Tutorial 7: Identifying limiting and excess reactants in a Chemical process.
8. Tutorial 8: Estimating the emissions factor for process in Chemical sector.
9. Tutorial 9: Estimating the flue gas composition for combustion of various fuels.
10. Tutorial 10: Estimating the energy changes in a chemical reaction.

TEXT BOOKS:

1. Stoichiometry & Process Calculations, Narayanan K.V., &Lakshmikutti B., Prentice Hall, 2006.

REFERENCE BOOKS:

1. Basic Principles & Calculations in Chemical Engineering, D.M.Himmelblau. 6th Ed., 2004
2. Stoichiometry, B.I.Bhatt & Thakore, Tata McGraw Hill Book Company, 5th Ed, 2010
3. Chemical Process Principles, Vol.1, O.A.Hougen, K.M.Watson, R.A.Ragatz., Indian print, CBS Publishers, 2nd Ed., 1995
4. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/127106019

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	**Outline** the various types of Unit Operations carried out in Industries for conversion of raw materials into products
CO 2	**Identify** different system of units and dimensions with concepts for expressing concentration 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.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Advanced Instrumentation Techniques (BEVPC402)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	1	0	4	4	50	50	25	25	150

COURSE OVERVIEW:

- To provide knowledge related to various analytical technique and instruments used in field of environmental science & technology

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Introduction to instrumental method of analysis:** Introduction, Scope of Analytical Instrumentation, Types of Instruments for Environmental Studies, Categories of Laboratory Instruments, Portable versus stationery analytical instrument. Performance requirements of analytical Instruments: Types of errors, definition of accuracy, precision, sensitivity, resolution and calibration.	1	6
2	**Spectrophotometry**: Spectral methods of analysis, Electromagnetic spectrum, Beer-Lambert law, UV-Visible spectrophotometry, Single and double beam instruments, IR Spectroscopy, Atomic absorption Spectroscopy, FTIR spectrophotometry, Flame emission Spectroscopy , Mass Spectroscopy	2	10
3	**Chromatography:** Different techniques, Techniques by chromatographic bed shape: Column chromatography, Paper Chromatography, Thin layer Chromatography, Applications; Techniques by physical state of mobile phase**:** Gas chromatography, Liquid chromatography, Applications; High-pressure liquid chromatography, Applications; Techniques by separation mechanism: Ion exchange chromatography, Applications.	3	10
	SECTION-B		
4	**pH Meters and Dissolved Component Analyzers:** Definition, Selective ion electrodes, principle of pH measurement and conductivity measurement, Different methods used for pH and EC measurement of soil sample.	4	6
5	**Air sampling and analyses:** Types of Air Sampling Instrumentation; Grab samples: evacuated containers, Vacutainer Syringe system, Gas Sampling Bags, Gas or Liquid Displacement Collectors, Features of Grab Air Sampling;	5	7

	Integrated Air Samplers: Simple gas wash bottles such as the Greenberg, midget impinge, Spiral Type Absorbers, Fritted Bubblers Instrumental Techniques and Measurement Range for various gases		
6	**Miscellaneous Methods:** Remote sensing, Dissolved oxygen sensors, TOC analyzer, Visual method and instrumental method of turbidity measurement, Online sensors. Introduction to OCEMS.	6	6

LIST OF TUTORIAL:

1. To demonstrate the working principle of pH meter.
2. To demonstrate the working principle of electrical conductivity meter
3. To demonstrate the working principle of Nephelo turbidity meter.
4. Separation of mixture of dyes using thin layer chromatography.
5. To demonstrate the working principle of Respirable Dust Sampler (RDS) which is used for analysis of ambient air.
6. To demonstrate the working principle of Fine Dust Sampler which is used for analysis of ambient air.
7. Demonstrate the Noise level meter for measuring sound at given location.
8. Colorimetric analysis using UV-Vis spectrophotometer.
9. To demonstrate the working principle of Flame Photometer.
10. To demonstrate the working principle of Anemometer
11. To determine the mean value and precision of a pH meter.
12. To study variation in turbidity readings of a sample.
13. To determine the sensitivity of a conductivity meter.
14. To study variation and accuracy of a DO meter.

TEXT BOOKS:

1. Khandpur R.S, "Handbook of Analytical Instruments", II Edition, Tata McGrawHill, New Delhi, 2006.
2. Braun, R.D., Introduction to Instrumental Analysis, Mc Graw – Hill, Singapore, 2006.
3. Eludoyin A. O., "Introduction to instrumentation measurements and field methods in environmental science", National Open University of Nigeria, 2010.

REFERENCE BOOKS:

1. H. H. Willard, L. L. Merritt, J. A. Dean, F. A. Settle, Instrumental methods of analysis, CBS publishing & distribution, 1995.
2. James keeler; Understanding NMR Spectroscopy, Second Edition John Wiley & Sons, 2010.
3. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and Francis group, 2007.
4. Standard methods for the examination of water and wastewater; published by American public Health Association, American water works Association, Water pollution control federation (21st Edition & later).
5. Chemistry for Environmental Engineering by Sawyer and M C Carty (4th Edition-McGraw-Hill Publishing Company Ltd.)
6. NPTEL Lecture Notes on, "Modern Instrumental Methods of Analysis" by Dr.J.R.Mudakavi, IISC, Bangalore.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/103108100

COURSE OUTCOMES:

After learning this course student will be able to:

CO 1	**Identify** various analytical method used in environmental science and technology.
CO 2	**Recognize** various techniques and methods of Spectral analysis.
CO 3	**Apply** the knowledge of chromatography to separate the constituents from a complex mixture.
CO 4	**Determine** appropriate analyzer for an Industrial requirement.
CO 5	**Explain** various Gas sensor and pollution monitoring instruments.
CO 6	**Summarize** the working of instruments as well as development of new technologies

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Wastewater Treatment - II (BEVPC403)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
3	0	2	5	4	50	50	25	25	150

COURSE OVERVIEW:

- To familiarize principles of biological wastewater treatment, microbial kinetics, and functioning of aerobic and anaerobic systems.
- To understand design and assess performance of biological treatment processes and sludge management systems for efficient wastewater treatment.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs. (45)
	SECTION-A		
1	**Fundamentals of Biological Treatment:** Overview of biological wastewater treatment, objectives of biological treatment, removal mechanism, objectives of biological treatment, Classification of treatment process, role of microorganisms in wastewater treatment, types of biological process in wastewater treatment, composition and classification of microorganism.	1	07
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, determination of bio kinetic coefficient, Determination of bio kinetic coefficients, MCRT, F/M ratio.	2	07
3	**Aerobic suspended growth biological treatment systems:** Aerobic Biological oxidation, Process description, and environmental factors, Modification in ASP: Complete Mix activated sludge, Operational problems for ASP, Extended Aeration system, Oxidation Ditch systems, Intermittently aerated and decanted systems, Oxygen activated sludge, Oxidation ponds, stabilization ponds, Secondary settling tank, oxidation ditch, secondary settling tank.	3	08
	SECTION-B		
4	**Aerobic attached Growth Biological Treatment systems:** Introduction to attached growth systems, Trickling Filter, Oxygen transfer and utilization, Applications rotating biological contactors, Bio-Towers, Introduction to MBBR & MBR. Design Examples for rotating biological contactor, trickling filter.	4	08
5	**Anaerobic Biological Wastewater Treatment:**	5	07

	Introduction, Removal Concept, System concept, anaerobic reactors (attached growth reactors): Packed bed reactor, extended bed reactor, fluidized bed reactor, up-flow anaerobic sludge blanket reactor, anaerobic reactors (suspended growth reactors): complete mix reactor, contact reactor, high rate and multi stage anaerobic digesters. Operational excellence of UASB		
6	**Sludge handling and management:** Sludge Bulking, Sludge Composting, Sludge Thickening, Sludge Composting, Sludge volume index, Sludge Dewatering techniques, Solar sludge drying Introduction & Brief description of Centrifuge, Belt filters press, Neutsch Filter, Filter Press, Decanter, Sludge Drying beds, Double drum dryer.	6	08

LIST OF PRACTICAL:

1. To determine Chemical Oxygen Demand of wastewater sample.
2. To determine Biochemical Oxygen Demand of wastewater sample.
3. To determine Dissolved Oxygen of wastewater sample.
4. To determine Coagulant Dose using Jar test Apparatus by varying coagulant dose.
5. To determine Coagulant Dose using Jar test Apparatus by varying pH of sample.
6. To determine Oil & Grease of wastewater sample
7. To determine Mix Liquor Suspended Solids of wastewater sample.
8. To determine Mix Liquor Volatile Suspended Solids of wastewater sample.
9. To determine Sludge Volume Index of wastewater sample
10. To determine colour of wastewater sample.

TEXT BOOKS:

1. Water Supply and Sanitary Engineering, Birdie and Birdie, Dhanpatrai and Sons, 1996.
2. Environmental engineering (Vol. I) - Water Supply Engineering S.K Garg & Rajeshwari Garg, Khanna Publishers, 23rd Edition, 2013.
3. Wastewater treatment concepts and design approach: GL Karia & R.A Christian.

REFERENCE 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.
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.

ONLINE RESOURCES:

- https://archive.nptel.ac.in/courses/127/105/127105018/
- https://archive.nptel.ac.in/courses/127/106/127106004/

COURSE OUTCOMES:

CO 1	**Explain** the principles of biological wastewater treatment, including classification of processes, role of microorganisms, and mechanisms of pollutant removal.
CO 2	**Analyze** microbial growth kinetics and evaluate biokinetic coefficients for biological treatment processes.
CO 3	**Apply** the principles of aerobic suspended growth systems to assess performance and operational conditions.
CO 4	**Use** design and operational concepts of attached growth systems such as trickling filters and rotating biological contactors for wastewater treatment.
CO 5	**Analyze** the design, operation, and performance of anaerobic treatment systems including UASB, fluidized bed, and anaerobic digesters.
CO 6	**Evaluate** sludge treatment, handling, and disposal methods including thickening, dewatering, composting, and drying systems.

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UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Green Technology Lab (BEVVS404)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
0	0	02	02	01	00	00	25	25	50

COURSE OVERVIEW:

This course provides hands-on experience in green chemistry, bioenergy, and environmental sustainability through experiments such as atom economy evaluation, biodiesel production from waste cooking oil, ethanol fermentation, and biochar synthesis from agricultural residues. It focuses on the analysis of biomass characteristics, including lignocellulosic composition, total solids (TS), and volatile solids (VS), along with the determination of biomethane potential to assess the suitability of organic substrates for anaerobic digestion. The course also covers advanced environmental remediation techniques such as plastic degradation using biopolymers and pollutant removal through Advanced Oxidation Processes (AOP). Additionally, it incorporates sustainability practices by enabling students to estimate their personal carbon footprint and propose effective reduction strategies, thereby strengthening their experimental, analytical, and problem-solving skills in environmental science and engineering.

LIST OF PRACTICAL:

1. To evaluate atom economy by studying selected chemical reactions.
2. To produce biodiesel from waste cooking oil using a laboratory-scale transesterification process.
3. To produce ethanol through fermentation.
4. To synthesize biochar from agricultural waste.
5. To analyze the lignocellulosic components (cellulose, hemicellulose, and lignin) of biomass.
6. To determine the biomethane potential of organic substrates by anaerobic digestion and evaluate their suitability for biogas production.
7. To estimate the total solids (TS) and volatile solids (VS) content of standard and feed samples to evaluate organic matter concentration and its suitability for biological treatment processes.
8. To study the degradation of plastic materials using biopolymers.
9. To study pollutant degradation using Advanced Oxidation Processes (AOP).
10. To estimate personal carbon footprint using an online calculator and propose effective reduction strategies.

ONLINE RESOURCES:

- http://vlab.amrita.edu/
- https://iitb.vlabs.co.in/

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	Understand the principles of green chemistry and apply the concept of atom economy

	to evaluate the efficiency and sustainability of chemical reactions.
CO 2	Explain biofuel production processes such as biodiesel synthesis, ethanol fermentation, and biochar production, and analyze their efficiency and yield under laboratory conditions.
CO 3	Analyze the composition of biomass by determining lignocellulosic components (cellulose, hemicellulose, lignin) and evaluate their significance in bioenergy production.
CO 4	Determine biomethane potential, total solids (TS), and volatile solids (VS) of organic samples, and evaluate their suitability for anaerobic digestion and biological treatment processes.
CO 5	Investigate pollutant degradation techniques including biopolymer-based plastic degradation and Advanced Oxidation Processes (AOP), and analyze their effectiveness in environmental remediation.
CO 6	Assess personal carbon footprint using digital tools and propose sustainable strategies to reduce environmental impact based on scientific understanding.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Waste Valorization (BEVPE405)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	0	3	3	50	50	00	00	100

COURSE OVERVIEW:

- This course introduces the concept of waste valorization and circular economy for sustainable resource management. The course focuses on converting different waste streams such as municipal, agricultural, industrial and plastic waste into value-added products like energy, fuels, chemicals and materials.
- To learn various biological, thermal and chemical waste conversion technologies, environmental benefits, economic aspects and recent innovations in waste-to-resource technologies.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1.	**Introduction to Waste Valorization**: Concept of waste as a resource, waste hierarchy, and circular economy concept, principles of waste valorization, global and Indian waste generation scenario, sustainability and SDGs related to waste management.	1	07
2	**Types and Characterization of Waste**: Municipal solid waste, agricultural waste, industrial waste, plastic waste, food waste and biomass residues; physical, chemical and biochemical characterization of wastes; importance of waste segregation and pre-treatment, drying and pelletalization.	2	08
3	**Biochemical conversion processes /technologies** Composting, vermicomposting, anaerobic digestion, biogas production, bio-methanation, fermentation for bio-ethanol and bio-chemicals, production of bio fertilizers from waste.	3	07
	SECTION-B		
4	**Thermal and chemical conversion processes/technologies**: Torrefaction, Combustion, pyrolysis, gasification, Incineration hydrothermal liquefaction, Characterization of products (char/solid, gas and oil) & Applications	4	08
5	**Resource Recovery and Value-Added Products**: Recovery of metals from E-waste, plastic upcycling technologies, waste-derived fuels (RDF), production of bio plastics, chemicals and construction materials from waste.	5	08
6	**Economic & Environmental Aspects**: Techno-economic analysis of waste valorization technologies, environmental benefits, challenges in implementation, case studies of successful waste valorization projects. Co processing of high calorific value waste, concept of green cement.	6	07

TEXT BOOKS:

1. Khanal S. K., Bioenergy and Biofuels from Biowastes and Biomass, ASCE Press.
2. Kumar S., Municipal Solid Waste Management, CRC Press.
3. Tchobanoglous G., Integrated Solid Waste Management, McGraw Hill.
4. CPHEEO Manual, Solid Waste Management (Govt. of India).

REFERENCE BOOKS:

1. Pandey A., Biomass, Biofuels and Biochemicals: Waste Valorization, Elsevier.
2. Basu P., Biomass Gasification, Pyrolysis and Torrefaction, Academic Press.
3. Singh J., Sustainable Resource Recovery and Zero Waste Approaches, Elsevier.
4. Yousuf A., Waste Biorefinery: Integrating Biorefineries for Waste Valorization, Elsevier.

ONLINE RESOURCES:

- https://archive.nptel.ac.in/courses/

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	**Understand** the concept of waste valorization and circular economy.
CO 2	**Classify** and characterize different types of waste streams.
CO 3	**Explain** biochemical methods for converting waste into useful products.
CO 4	**Describe** thermochemical technologies for waste-to-energy conversion.
CO 5	**Identify** methods for recovering resources and producing value-added products from waste.
CO 6	**Evaluate** environmental and economic aspects of waste valorization technologies.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Environmental Risk Management (BEVPE406)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
3	0	0	3	3	50	50	0	0	100

COURSE OVERVIEW:

- The graduate engineer employed in SHE department of industry requires knowledge of matters relating to human health risks and their mitigation.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (45)
	SECTION-A		
1	**Scope of Sustainability:** Need and concept of sustainability, pillars of sustainability, sustainable development and challenges, nexus between technology and sustainable development, Global Environmental Issues.	1	7
2	**Sustainable Resource and Carbon Management:** 5R concept, clean development mechanism (CDM). Circular economy, Carbon footprint, Carbon trading, Carbon Emission Scope (1, 2 and 3).	2	7
3	**Environmental Management Standards**: ISO 14000 series, Life Cycle Analysis (LCA) -scope and goal, bio-mimicking, Environment Impact Assessment (EIA).	3	7
	SECTION-B		
4	**Maximum Credible accidents (MCA) analysis:** Hazard indices viz. Dow's fire and explosion. Indexc (FEI) and MOND index – degree of hazard – toxicity index.	4	08
5	**Consequence analysis:** Development and assessment of various scenarios, determination of extent of damage.	5	08
6	Disaster Management Plan (DMP) and Emergency preparedness plan (EDP)	6	07

TEXT BOOKS:

1. Hand book of Environmental Impact Assessment vol –1: By Judith petts,
2. The Risk Assessment of Environmental and Human Health Hazards (Text book of case studies): By Paustenbach, D.ceds
3. Hand book of Env Risk Assessment and Management Edited: By Peter Callow
4. Environmental Risks and Hazards: By Cutter and Susan.

COURSE OUTCOMES:

After learning this course, students will be able to:

CO 1	Explain and analyze the concepts, significance, and methodologies of environmental risk assessment and management, including the "what, why, and how" aspects.
CO 2	Analyze risks to human health and ecological systems from chemicals and evaluate risk management strategies, including waste treatment, risk communication, and economic valuation of risks
CO 3	Apply the steps of the risk assessment process—hazard identification, hazard assessment, risk estimation, evaluation, and mitigation—in real-world environmental scenarios.
CO 4	Apply hazard indices such as Dow's Fire and Explosion Index (FEI), MOND index, and toxicity index to evaluate the degree of industrial hazards and accident scenarios.
CO 5	Analyze potential accident scenarios and assess the extent of damage using consequence analysis techniques.
CO 6	Design and evaluate disaster management and emergency preparedness plans for industrial and environmental risk scenarios.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Universal Human Values (BUNVA431)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	0	0	100

COURSE OVERVIEW:
This course introduces second-year B.E. Course helps the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Introduction to Value Education :** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity–the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity–Current Scenario, Method to Fulfill the Basic Human Aspirations.	1	5
2	**Harmony with self:** Importance of self-awareness: Self-reflection. Who am I? – Imagination & Action. Understanding & exploring needs of self and body. Self -Exploration – A Process of Fundamental Human Desires – Happiness, Peace and Contentment for Material, Behavioral and Intellectual well Being. Holistic understanding of mind & body. The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health	2	5
3	**Harmony in the Family:** Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation.	3	5
	SECTION-B		
4	**Harmony in the Society:** Understanding Harmony in the Society: Resolution, Prosperity, fearlessness (trust) and co-existence as Comprehensive human goals, Visualizing a universal harmonious order in society.	4	5
5	**Harmony in the Nature/ Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at all levels, The Holistic perception of Harmony in Existence.	5	5

6	**Harmony for Global peace:** Understanding global peace. Concept of वसुधैव कुटुम्बकम- one earth one family. Fostering Universal brotherhood and unity, collaborative problem solving, respecting cross cultural communication. Famous anecdote and relevant case studies	6	5

TEXT BOOKS:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1.
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi,, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book)
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. F Schumacher, "Small is Beautiful".
6. Cecile Andrews, "Slow is Beautiful".
7. J C Kumarappa, "Economy of Permanence"
8. Pandit Sunderlal, "Bharat Mein Angreji Raj"
9. Dharampal , "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad , "India Wins Freedom"
12. Romain Rolland, "Vivekananda" (English)
13. Romain Rolland, "Gandhi" (English)

ONLINE RESOURCES:

- https://www.uhv.org.in
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

COURSE OUTCOMES

CO1	**Understand and analyze** the concept of value education, self-exploration, and the basic human aspirations of continuous happiness and prosperity, along with methods to achieve them.
CO2	**Develop** self-awareness through self-reflection and explore the harmony between self and body for achieving holistic well-being and self-regulation.
CO3	**Inculcate** values such as trust and respect to strengthen harmony in family and interpersonal relationships.
CO4	**Evaluate** the role of individuals in building a harmonious society based on resolution, prosperity, fearlessness, and co-existence.
CO5	**Understand** the interconnectedness in nature and apply the principles of mutual fulfillment and co-existence for sustainable living.
CO6	**Develop** a global perspective by promoting universal brotherhood, cultural harmony, and collaborative problem-solving for achieving global peace.