GUJARAT VIDYAPITH: AHMEDABAD
Faculty of Science and Applied Science, Sadra,
Department of Biogas Research and Microbiology
M.Sc (Environmental Science and Technology) (Semester I to IV)
Effective from June 2023

Availability of time for direct teaching in each semester = 15weeks = **517.5 hours** (15weeks × 34.5 hours)
Monday to Friday (excluding prayer and recess)= 30 hours (6 hours × 5 days)
Saturday (excluding prayer and recess) = 4.5 hours
Therefore 1week = 34.5 hours

M.Sc. (Environmental Science and Technology)Semester-1							
Sr. No.	**Course Code**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	EST-101	Research Methodology and Scientific Writing	First	60	-	4	-
2	EST-102	Eco-Technology	First	60	60	4	2
3	EST-103	Environmental Pollution	First	60	60	4	2
4	EST-104	Environmental Statistics	First	60	-	4	-
5	Community Life	Community Life	First	-	-	-	-
Total				**240**	**120**	**16**	**4**

Available Total Credits= 20 Total required hours per semester=360

Total available hours per semester=517.5 hours

Available hours per week= 34.5 hours

Calculation of required hours per week

16 credits for theory=**16 hours**

4 credits for practicals=**8 hours**

Total required hours per week=24 hours, Extra hours =10.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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Faculty of Science and Applied Science
Department of Biogas Research and Microbiology
M.Sc.(Environmental Science and technology) Semester-I
EST-101: Research Methodology and Scientific Writing
(Syllabus of theoretical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=04)

Learning outcomes:

- Students will learn to verify and test important facts of research.
- Students will learn to analyse an event or process or phenomenon to identify the cause and effect relationship.
- Students will learn to develop new scientific tools, concepts and theories to solve and understand scientific problems.
- Students will learn to overcome or solve the problems occurring in our everyday life in a scientific way.
- Students will learn to introduce the concept of scientific research and the methods of conducting scientific inquiry.

Unit	Topic and Content	Hours
	Research Methodology	**(15 h)**
1	1. Research methodology: An Introduction: Creativity, innovation, originality and advancement of knowledge and application to the society	04
	2. Define the research problem	03
	3. Methods of Research	05
	4. Ethics in research	03
	Research Design	**(15 h)**
2	1. Meaning and Objectives,	03
	2. Characteristics of good research design.	04
	3. Components of the research design.	04
	4. Review of literature.	04
	Research Project and Research Proposals	**(15 h)**
3	1. Selecting a Research Topic.	02
	2. Project Planning.	03
	3. Identifying funding sources and special founding mechanisms.	03
	4. Writing a Proposal.	04
	5. Research Ethics and Responsibilities.	03
	Scientific Writing (From Research to Manuscript)	**(15 h)**
4	1. Tools and Techniques.	04
	2. The Scientific Paper.	04
	3. Scientific writing skills.	04
	4. Preparing to Publish.	03

References

1. Research Methodology: Methods and Techniques. (Second Revised Edition: New Age International Publishers: **2004**) By C.R. Kothari.
2. Research Projects and Research Proposals (A Guide for Research Scientist, Fellow seeking Funds: **2004**: Cambridge, U.K.) BY Paul G. Chapin.
3. From Research to Manuscript (A Guide to Scientific Writing: U.S.A. Springer: **2006**) By Michael Jaykatz.
4. Writing Skills (Success in 20 minutes a Day: Learning Express Skill Builders: New York: **1998**) By Judith F. Olson.
5. Research Methodology, Panneerselvam, R., Prentice Hall of India, New Delhi, **2004**.

GUJARAT VIDYAPITH : AHMEDABAD
Faculty of Science and Applied Science
Department of Biogas Research and Microbiology
M.Sc.(Environmental Science and technology) Semester-I
EST -102: Ecotechnology
(Syllabus of theoretical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=04)

Learning outcomes:

•Student will learn various technologies available for sustainable development of villages.
•Student will learn various techniques to be used for rural cleanliness.
•Student will learn various techniques available to restore degraded eco-system.
•Student will learn the concept of Eco-village.

Unit	Topic and Content	Hours
1	**Introduction to Eco-Technology**	**(15 h)**
	Ecotechnology: Definition, concept and perspective, Eco-designing, Ecotechnology for social welfare and sustainable development. Ecotechnology for rural development. Selection of appropriate technology for rural environment: Biogas technology for rural environment, community biogas plants; Bioenergy, Agro chemicals, Biological Control measures.	
2	**Eco technology in cleaner production**	**(15 h)**
	Clean bioprocess technology: History, concept, planning and strategies for urban and rural sustainability. Bioprocess for cleaner production, Dairy industry production, organic farming, Agro eco farming, Eco-farming Perspectives, Food sovereignty regarding rural livelihood, smarter food production and yield, Eco engineering technology, Green Building, Biosanitizer Ecotechnology, Odourless self-flushing bio-toilets.	
3	**Eco-technological restoration**	**(15 h)**
	Concept and importance of SPS (Sanitary and Phytosanitary), WTO-SPS agreement, sanitation and phyosanitation technology Green inhibiter: Environmental green inhibitor. Eco system dynamics: Restoration of degraded eco system using ecological approach, wasteland, mining area, building resilience, Ecological resilience, soil fertility management; water resource management.	
4	**Eco Village Development**	**(15 h)**
	Transfer of technology from lab to land: Barren land reclamation using Mycorrhiza, solid waste management, development of compost, vermi compost and Bio energy, Solar based technology for water purification, Pesticides remediation using rhizosphere technology, Phytostabilization of contaminants, Water harvesting, Pond water reservoir, Microalgae based energy generation, Eco plantation.	

References

1. E.P. Odum (1996) Fundamentals of Ecology, Nataraj Publisher, DehraDun.

2. Mitsch, William & Jørgensen, S.E. (1989). Ecological Engineering: An Introduction to Ecotechnology.
3. R. K. Trivedy & Arvind Kumar, (1998). Ecotechnology for Pollution Control and Environmental Management.
4. R.C. Rajak , (2000). Microbial Biotechnology for Sustainable Development and Productivity.
5. Joanne E. Norris, Alexia Stokes, Slobodan B. Mickovski, Erik Cammeraat, Rens van Beek, Bruce C. Nicoll, Alexis Achim, (2008). Slope Stability and Erosion Control: Ecotechnological Solutions.
6. William J. Mitsch (2004). Ecological Engineering and Ecosystem Restoration.

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M.Sc.(Environmental Science and technology) Semester-I
EST -102: Ecotechnology
(Syllabus of practical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=02)

Learning outcomes:

- Student will be able to analyse biogas slurry, compost and soil for its nutrients content.
- Student will be able to enhance their practical skill.
- Student will learn to calculate and interpret the results.
- Students will be able to find out microbial populations in soil and compost.

Practicals:

1. Demonstration of media preparation, sterilization, cultivation of microorganisms, isolation and identification of microorganisms (bacteria and fungi).
2. Standard Plate Count (SPC) of pristine and contaminated soil samples.
3. Find out Total fungal count (TFC), Total Yeast Count (TYC), Total Actinomycetes Count (TAC) and Total Azotobacter Count (TAC) from compost sample.
4. Seed germination test of untreated and treated wastewater.
5. Estimation of organic carbon from biogas slurry by Walkley and Black (WB) method.
6. Estimation of nitrogen content from biogas slurry by kjeldahl method.
7. Measurement of Total Volatile Fatty acid from inlet and outlet of biogas plant.
8. Analysis of moisture content from compost.
9. Methane measurement from biogas slurry by orset appratus. (Demo practical)

GUJARAT VIDYAPITH : AHMEDABAD
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Department of Biogas Research and Microbiology
M.Sc.(Environmental Science and technology) Semester-I
EST-103: Environmental Pollution
(Syllabus of theoretical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=04)

Learning outcomes:

•Student will learn various types of pollution.
•Student will learn the impact of various types of pollution on health of living beings.
•Student will learn various techniques used to control these pollution.

Unit	Topic	Hours
1	**Air Pollution**	**(15 h)**
1.1	Definition& Introduction	01
1.2	Natural sources of air pollution	01
1.3	Human caused air pollution	01
1.4	Classification of air pollutants	01
1.5	Transport and diffusion of pollutants	01
1.6	Effect of air pollutants on human health, plants, animals, microbes and materials.	03
1.7	Air pollution episodes: Bhopal, Chernobyl, Los Angeles, London smog, Indonesian forest fire	02
1.8	Acid rain	01
1.9	Ozone depletion	01
1.10	Global Warming and climate changes	01
1.11	Air quality indices and Air Pollution Control	02
2	**Water Pollution**	**(15 h)**
2.1	Definition & Introduction	01
2.2	Types of water pollution	01
2.3	Effect of water pollution	01
2.4	Physico-chemical and microbial characteristics of domestic, industrial and agricultural waste water.	03
2.5	River pollution	01
2.6	Marine pollution	01
2.7	Drinking and irrigation water quality parameters: Criteria and standards Municipal water treatment & Treatment of water for Industrial use	02
2.8	Water pollution control	01
3	**Soil Pollution**	**(15 h)**
3.1	Definition & Introduction	01
3.2	Sources and types of soil pollution -Impact of usage of land for solid waste disposal of both municipal solid waste and industrial solid waste -Disposal of hazardous solid waste (heavy metals, toxic organic compounds) on land and its impact on soil pollution - Deterioration of soil due to mining activities	02 01 01 01
3.3	Physico-chemical and microbial characteristics of soil pollutants	03

3.4	Adverse effect of soil pollutants	03
3.5	Remedial measures of soil pollution	03
4	**Noise and Radioactive Pollution**	**(15 h)**
4.1	Characteristics of sound wave	01
4.2	Sources of noise pollution	02
4.3	Measurement of noise level and indices	01
4.4	Noise exposure levels and standards	01
4.5	Noise control and abatement measures	01
4.6	Sound pressure level	01
4.7	Noise-spectra-octave bands	01
4.8	Combining decibels	01
4.9	Impact of noise pollution on human health	01
4.10	Types, sources and consequences of radioactive pollution	01
4.11	Models of radioactive decay	01
4.12	Radioactive exposer to human and environment	01
4.13	Remedial Measures	02

Reference books

1. Eldon Enger, Bradley Smith, Environmental Science: A study of inter relationship, Mc Graw-Hill Education; 14 edition (2015).
2. Ambasht R.S. And Ambasht P. K., Environment and Pollution, CBS Publishers And Distirbutors; 5th edition (2014).
3. Khitoliya R. K., Environmental Pollution, S.Chand Publishing, 2nd edition (2012).
4. Merrill Eisenbud, Thomas Gesell, Environmental Radioactivity from Natural, Industrial and Military Sources, Academic Press, 4th edition, (1997).
5. William P. Cunningham, Barbara Woodworth Saigo., Environmental science : a global concern,Wm. C. Brown Publishers,5th edition(1999).

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Faculty of Science and Applied Science
Department of Biogas Research and Microbiology
M.Sc.(Environmental Science and technology) Semester-I
EST-103: Environmental Pollution
(Syllabus of practical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=02)

Learning outcomes-

- Students will be able to find out potability of water.
- Students will be able to analyse air, water and soil samples for its various parameters.
- Students will be able to enhance their hands-on-practice of analysis.

1. Estimation of the amount of oxides of sulphur in the ambient air **(10 hours)**
2. Estimation of the amount of oxides of nitrogen in the ambient air **(10 hours)**
3. Physico -chemical characterization of ground water and comparison with drinking and irrigation standards **(20 hours)**
4. Measurement of noise level in industrial and residential area **(10 hours)**
5. Determination of pH, electrical conductivity and organic matter in soil **(10 hours)**

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Department of Biogas Research and Microbiology
M.Sc.(Environmental Science and technology) Semester-I
EST-104: Environmental Statistics
(Syllabus of theoretical portion) (In force from June, 2023)
(External Evaluation: 60% + Internal Evaluation: 40%)
(Total Teaching Hours=60, Credit=04)

Learning outcomes:

•Student will learn to collect data for statistical analysis.
•Student will learn to apply various statistical measures.
•Student will learn fundamentals of computer and bioinformatics.

Unit	Topic	Hours
1	**Basics of statistics**	**(15 h)**
	Introduction to Statistics;	02
	Collection, classification and tabulation of data	08
	Frequency distribution	05
2	**Statistical measures**	**(15 h)**
	Measures of location- Arithmetic mean, median and mode	05
	Measures of dispersion- Range, standard deviation, coefficient of variation, skewness, kutosis	10
3	**Statistical analytical techniques**	**(15 h)**
	Tests of hypotheses	03
	Correlation and Regression	06
	Probability - normal, poisson and binomial	06
4	**Bioinformatics and designing of experiments**	**(15 h)**
	Bioinformatics and its applications	05
	Design of experiment, microsoft excel, microsoft access, SPSS	10

References and suggested readings:

1. G. Nageswara Rao, Statistics for Agricultural Sciences, Oxford and IBH Publishing Co., New Delhi
2. Zar, Jerrold H. (1998). Biostatistical Analysis. Prentice Hall, N.J.
3. Textbook of Computer applications and biostatistics- ebook, Dr. S. B. Bhise, Dr. R. J. Dias, K. K. Mali and P. H. Ghanwat, Trinity publishing house, Satara
4. Modeling Tools for Environmental Engineers and Scientists, by N. Nirmala Khandan, CRC PRESS
4. Sokal, Robert and James Rohlf (1997). Biometry, Freeman Press, N.Y.
5. Walpole, R. and R. Myers (1993). Statistics for Engineers and Scientists, 5th edn. MacMillan, N.Y.
6. Wayne, R. Ott (1995). Environmental Statistics and Data Analysis, CRC Press.
7. Manly (2001) Statistics for environmental science and management, Chapman and Hall / CRC.
8. Ramsay and Schafer (1997). The Statistical Sleuth, Duxbury Press.