UPL -University of Sustainable Technology

SRICT Institute of Science & Research

Syllabus of
2nd Year M. Sc. Environmental Science

As Per National Education Policy 2020 (NEP 2020)

UPL UNIVERSITY OF SUSTAINABLE TECHNOLOGY

UPL University of Sustainable Technology

SRICT- Institute of Science & Research

AY-2025-2026

UPL -University of Sustainable Technology

SRICT Institute of Science & Research

UPL University of Sustainable Technology, Ankleshwar				
SRICT- Institute of Science & Research (SRICT-ISR)				
2nd Year M. Sc. Environmental Science				
SEM	**TYPE OF COURSE**	**COURSE CODE**	**NAME OF SUBJECT**	**Credits**
3	**MAJOR**	ESM500-5C	Environmental Ecology & Biodiversity	**4**
	MAJOR	ESM501-5C	Toxicology & Environmental Analysis	**4**
	MAJOR	ESM502-5C	Climate, Sustainability & Governance	**4**
	MAJOR	ESM503-5C	Environmental Science Practical-III	**6**
	CORE COURSE	ESR500-5C	Research Project-I	**4**
			Total Credits	**22**
4	**MAJOR**	ESM504-5C	Environmental Analytics & Applications	**4**
	MINOR	ESE500-5C	Research Methodology	**2**
	CORE COURSE	ESR501-5C	Research Project-II	**16**
			Total Credits	**22**

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Teaching/Exam Scheme

M. Sc. Sem. III

Sr. No.	Course Code	Category of course	Course title	Hour s Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	ESM500-5C	Major Course	Environmental Ecology & Biodiversity	4	0	-	4	4	50	50	-	-	100
2	ESM501-5C	Major Course	Toxicology & Environmental Analysis	4	0	-	4	4	50	50	-	-	100
3	ESM502-5C	Major Course	Climate, Sustainability & Governance	4	0	-	4	4	50	50	-	-	100
4	ESM503-5C	Major Course	Environmental Science Practical-III	-	-	12	12	6	75	75	-	-	150
5	ESR500-5C	Core Course	Research Project-I	-	-	8	8	4	-	-	50	50	100
			Total	12	0	20	32	22	225	225	50	50	550

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Master of Science

Course Code: ESM500-5C

Course Name: Environmental Ecology & Biodiversity

Semester: III

w.e.f.: July 2026

Type of course: Major Course

Prerequisite: Should have underlying knowledge of environmental science, ecology, and microbiology.

Rationale: At the end of the course, the students should be able to enhance understanding of microbial ecology, ecosystem processes, biodiversity patterns, and ecological dynamics essential for analyzing environmental systems. It develops scientific knowledge required for biodiversity conservation, ecosystem restoration, and climate change response, enabling learners to address environmental challenges and support sustainable ecosystem management.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	0	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Fundamentals of Ecology and Systems Approach** Scope and levels of ecological organization, Ecosystem structure and functional attributes, Biotic and abiotic components and ecological factors, Habitat, niche, and ecological amplitude, Systems ecology: energy flow, feedback mechanisms, resilience and stability, Ecosystems as complex adaptive systems.	9
2	**Ecosystem Processes and Biogeochemical Cycles** Trophic structure: food chains, food webs, ecological pyramids, Ecological energetics and productivity (GPP, NPP, secondary productivity), Biogeochemical	9

	cycles and nutrient dynamics, Carbon Cycle, Nitrogen Cycle, Coupling of biogeochemical cycles (C–N–P interactions), Climate–ecosystem interactions and carbon sequestration.	
3	**Population, Community and Microbial Ecology** Population attributes: growth, regulation, and carrying capacity, Species interactions and population dynamics, Community structure, succession, ecological niche, Diversity–stability relationships and ecosystem functioning, Diversity of microorganisms in natural environments, Functional microbial groups (decomposers, nitrifiers, denitrifiers, methanogens), Microbial interactions and syntrophic associations, Role of microbes in nutrient cycling and ecosystem processes for eg. Anaerobic Digestion.	**12**
SECTION - B		
4	**Biodiversity and Biogeography** Levels of biodiversity: genetic, species, ecosystem, Species richness, evenness and diversity indices, Alpha, beta and gamma diversity, Biogeographical regions and distribution patterns, Study of Western GhatsEastern Himalayas, Landscape ecology and habitat fragmentation, Tools for biodiversity assessment (GIS and remote sensing overview).	**9**
5	**Biodiversity Conservation, Policy and Governance** In-situ and ex-situ conservation strategies, Protected area networks and biodiversity management, Threats to biodiversity: habitat loss, invasive species, pollution, climate change, Global frameworks: Convention on Biological Diversity, IUCN, National environmental policies and biodiversity laws (India), Environmental governance, ESG (Environmental, Social, Governance) and sustainability reporting, Natural capital and ecosystem valuation.	**9**
6	**Applied Ecology, Restoration and Environmental Management** Ecosystem services and their classification, Ecological restoration principles and practices, Wetland, forest and river restoration approaches, Environmental Impact Assessment (EIA), Bioremediation and phytoremediation, Wastewater treatment	**12**

	ecology and microbial processes, Resource recovery and circular bioeconomy, Sustainable technologies and nature-based solutions, Metagenomics	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**20**	**15**	**15**

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

Text Books:

1. Kevin J. Gaston, John I. Spicer, Biodiversity: An Introduction, 2nd Edition, Blackwell Science Ltd, ISBN 1-4051-1857-1, 2004.
2. Grzegorz Peszko; Markus Amann; Yewande Awe; Gary Kleiman; Tamer Samah Rabie, Air Pollution and Climate Change, ISBN: 1464818355, 2022.
3. Dorothy F. Boorse, Environmental Science Toward a Sustainable Future: 11th Edition, Pearson Education, ISBN-9780134857169, 2017.

Reference Books:

1. Raina M. Maier, Ian L. Pepper, and Charles P. Gerba, Environmental Microbiology, Elsevier Science, ISBN: 9780123948175 , 2014.
2. Sandra Diaz, Biodiversity: Concepts, Patterns, Trends, and Perspectives, DOI:10.1146/annurev-environ-120120-054300, 2022.
3. Odum, Eugene P., Fundamentals of ecology, Belmont, CA : Thomson Brooks, SBN: 0721669417, 2019.
4. Bruce E. Rittmann, Perry L. McCarty, Environmental Biotechnology, Tata McGraw Hill Education Private Limited, ISBN- 9781259002885, 2012.
5. Ronald M. Atlas, Microbial Ecology: Fundamentals and Applications, 2nd Edition, Benzamin Cummings Publishing Company Inc., ISBN- 978-81-378-1384-6, 1998.
6. F Stuart Chapin III, Pamela A. Matson, Peter Vitousek, Principles of Terrestrial Ecosystem Ecology, 2nd Edition, ISBN- 978-1-4419-9503-2, Springer Newyork, 2011.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain ecological processes using systems-based approaches .	20%
CO-2	Quantitatively assess biodiversity and interpret ecological data.	15%
CO-3	Evaluate microbial roles in environmental and engineered systems.	15%
CO-4	Critically analyze conservation policies and sustainability frameworks.	15%
CO-5	Apply ecological concepts in environmental management and industry contexts.	15%
CO-6	Apply conservation and restoration principles for sustainability.	20%

List of Open Source Software/learning website:

1. NPTEL- Ecology and Environment https://onlinecourses.nptel.ac.in/noc19_ge23/preview
2. https://www.vbspu.ac.in/e-content/Biodiversity.pdf
3. United Nations Sustainable Development Goals - SDGs resources, biodiversity and sustainability learning materials
4. NASA Earth Observatory - Climate, ecosystems, and Earth system data
5. NOAA - Climate change, oceans, and environmental datasets
6. Convention on Biological Diversity- Biodiversity conservation resources and reports
7. FAO - Soil microbiology, agriculture, and ecosystem management resources.
8. https://www.r-project.org
9. https://qgis.org

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Master of Science
Course Code: ESM501-5C
Course Name: Toxicology & Environmental Analysis
Semester: III

w.e.f.: July 2026

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of toxicology, biology, analytical techniques, and environmental science.

Rationale: At the end of the course, the students should be able to develop a comprehensive understanding of toxic substances, their sources, environmental distribution, and biological effects. The course enables students to analyze pollutants, understand toxicokinetics and toxicodynamics, apply analytical techniques for environmental monitoring, and evaluate the impact of contaminants on human health and ecosystems, thereby equipping them for research and practical applications in environmental protection and public health.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	0	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Fundamentals of Toxicology** Definition, scope and history of toxicology, Concepts: toxicity, dose–response relationship, exposure pathways, Types of toxic effects: acute, chronic, sub-chronic toxicity, Absorption, distribution, metabolism and excretion (ADME) of toxicants, Factors influencing toxicity.	**9**
2	**Environmental Toxicants** Classification of environmental pollutants, Heavy metals toxicity (Hg, Pb, Cd, As), Pesticides and agrochemicals toxicity, Industrial chemicals, solvents and hydrocarbons, Emerging pollutants: pharmaceuticals, microplastics, endocrine disruptors.	**9**

3	**Ecotoxicology** Toxic effects on terrestrial and aquatic ecosystems, Bioaccumulation, biomagnification and bioconcentration, Toxicity testing methods (LC_{50}, EC_{50}, bioassays), Biomarkers and ecological risk assessment, Impact on biodiversity and food chain.	**10**
SECTION - B		
4	**Environmental Sampling & Monitoring** Principles of environmental sampling, Sampling techniques for air, water, soil and biota, Sample preservation and handling, Quality assurance and quality control (QA/QC), Environmental standards and regulatory guidelines.	**9**
5	**Environmental Analytical Techniques** Classical analytical methods: titrimetry and Gravimetry, ICP-AES, ICP-MS, TOC, Ion chromatography. Spectroscopic techniques: UV–Vis, AAS, FTIR, Chromatographic techniques: GC, GC-MS, HPLC, Instrument calibration and validation, Detection and quantification of pollutants.	**13**
6	**Risk Assessment & Environmental Management** Toxicological risk assessment framework, Exposure assessment and hazard identification, Human health risk assessment, Environmental Impact Assessment (EIA) concepts, Pollution control strategies and sustainable environmental management.	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**20**	**15**	**15**

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

Text Books:

1.Cartwright, M., Ahmad R. Analytical Methods for Environmental Monitoring (2001) Pearson; 1st Edition,. Taylor, F.,

2. Hayes, A. W. (2008), Principles and Methods of Toxicology, 5th Edition, Boca

Raton, FL, Taylor and Francis.

3. Ahmad, R., Cartwright, M., & Taylor, F. (2001). Analytical methods for environmental monitoring. Harlow, England: Prentice Hall.
4. De, A. K. Environmental Chemistry. New Age Int. Ltd. New Delhi. 2003.

Reference Books:

1. Fifield F.W and Haines P. J. (2000) Environmental analytical chemical. Black well Science, pp 490.
2. Cockerham, Lerris, G., and Barbara, S. Shane, "Basic Environmental Toxicology", CRC Press/Lewis Publishers, Boca Raton, FL, 1994.
3. Donald, G. G. Environmental Toxicology and Chemistry. Oxford University Press: New York and Oxford. 1998.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain fundamental principles and concepts of toxicology.	20%
CO-2	Identify major environmental toxicants and their sources.	15%
CO-3	Evaluate toxic effects on organisms and ecosystems using ecotoxicological approaches.	15%
CO-4	Apply environmental sampling and monitoring techniques for pollution assessment.	15%
CO-5	Analyze environmental samples using modern analytical instruments.	15%
CO-6	Assess environmental and human health risks and propose sustainable management strategies.	20%

List of Open Source Software/learning website:

1. NPTEL- Environmental Toxicology- https://archive.nptel.ac.in/content/storage2/courses/120108002/module8/lecture21.pdf
2. https://www.epa.gov/chemical-research/ecotoxicological-assessment-modeling
3. https://www.eolss.net/sample-chapters/c09/E4-11-04-03.pdf

4. https://www.lamar.edu/engineering/research/center-for-advances-in-water-and-air-quality/fate-and-transport-of-pollutants-in-the-environment.html

5. https://fiveable.me/environmental-chemistry-ii/unit-12/chromatographic-spectroscopic-techniques-environmental-analysis/study-guide/kLe8bCuzvQn5OWcz

6. https://chromtech.com/environmental-applications-of-chromatography/?srsltid=AfmBOorFaYixtsSIs8ehZvP_8NI9vqt29IirubneMdV6AdYvw4zGar_8

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Master of Science
Course Code: ESM502-5C
Course Name: Climate, Sustainability & Governance
Semester: III

w.e.f.: July 2026

Type of course: Major Course

Prerequisite: Should have underlying knowledge of Environmental Science, Ecology, and Earth System processes.

Rationale: At the end of the course, the students should be able to enhance knowledge of climate systems, ecosystem responses, environmental governance, sustainability frameworks, and geospatial technologies. It equips students with scientific understanding and practical tools required for environmental assessment, policy implementation, and sustainable natural resource management in the context of global environmental change.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	0	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Climate System and Climate Change** Earth's climate system: atmosphere, hydrosphere, lithosphere and biosphere, Weather vs climate, Greenhouse effect and global warming, Drivers of climate change: natural and anthropogenic factors, Evidence and indicators of climate change.	**9**
2	**Climate Change Impacts** Impacts on ecosystems and biodiversity, Climate change and water resources, Agriculture and food security, Human health and urban systems, Extreme events: floods, droughts, heat waves and sea-level rise.	**9**
3	**Climate Mitigation and Adaptation** Climate mitigation strategies, Renewable energy and low-carbon development,	**12**

	Carbon footprint and carbon sequestration, Climate adaptation and resilience planning, Nature-based solutions and ecosystem restoration. Corporate social responsibility (CSR) in the field of climate change.	
SECTION - B		
4	**Sustainability Concepts and Practices** Concept and pillars of sustainability, Sustainable Development Goals (SDGs), Circular economy and resource efficiency, Sustainable consumption and production, Green technologies and sustainable lifestyles, Cleaner Technology, Zero Liquid Discharge (ZLD).	**9**
5	**Environmental Governance and Policy** Environmental governance concepts, Environmental regulations, National environmental policies and legislation, Role of institutions and regulatory bodies, Environmental ethics and public participation, Corporate environmental responsibility and ESG frameworks, Quality standards, National Green Tribunal (NGT). Extended producer responsibility (EPR).	**8**
6	**Global Climate Governance** International climate agreements and conventions, United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement, Climate finance and carbon markets,Climate diplomacy and global cooperation mechanisms.	**13**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**20**	**15**	**15**

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

Text Books:

1. Dag Hammarskjöld Library, Climate Change - A Global Issue, United Nationas, USA. https://research.un.org/en/climate-change.

2. Grzegorz Peszko; Markus Amann; Yewande Awe; Gary Kleiman; Tamer Samah Rabie, Air Pollution and Climate Change, ISBN: 1464818355, 2022.
3. Vartika Singh, Applications of Remote Sensing and GIS in Geosciences, New India Publishing Agency, ISBN- 9789358879711, 2024.

Reference Books:

1. Rebecca S. Epanchin-Niell, James W. Boyd, Molly K. Macauley, Lynn Scarlett, Carl D. Shapiro, Byron K. Williams, Integrating Adaptive Management and Ecosystem Services Concepts to Improve Natural Resource Management- Challenges and Opportunities, U.S. Geological Survey, ISBN: 9781411342217, 2018.
2. Angus Morrison-Saunders, Jos Arts, Assessing Impact: Handbook of EIA and SEA Follow-up, ISBN- 9781849770507, Earthscan, 2012.
3. B. Dente, Environmental Policy in Search of New Instruments, ISBN- 9789401585040, Springer Netherlands, 2013.
4. Kenneth R. Richards, Handbook of Policy Instruments in Environmental Law, ISBN: 978 1 78536 567 6, 2020.
5. Sairam Bhat, Environmental Law and Policy in India, ISBN 9781032703886, 1st Edition, Routledge, 2024.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain climate system processes and causes of climate change.	20%
CO-2	Assess environmental, social and economic impacts of climate change.	15%
CO-3	Evaluate climate mitigation and adaptation strategies for sustainable development.	15%
CO-4	Apply sustainability principles in environmental planning and resource management.	15%
CO-5	Analyze environmental governance structures, policies and regulatory frameworks.	15%
CO-6	Interpret global climate agreements and contribute to climate governance initiatives.	20%

List of Open Source Software/learning website:

1. Climate Risk, Adaptation and Sustainable Development- https://onlinecourses.nptel.ac.in/noc26_ge06/preview
2. https://www.uncclearn.org/wp-content/uploads/library/wmo100.pdf
3. https://uou.ac.in/sites/default/files/slm/ENS-509.pdf
4. https://training.iaia.org/wp-content/uploads/2023/11/SEAManual.pdf
5. https://www.google.co.in/books/edition/Natural_Resources_Management_in_Agricult/CqVoz7LUHfIC?hl=en&gbpv=1&dq=Natural+resources+management+and+ecosystem+services&pg=PA20&printsec=frontcover
6. https://moef.gov.in/uploads/2019/10/Biodiversity_ClimateChange.pdf
7. https://cprindia.org/wp-content/uploads/2022/12/Indian-Environmental-Law_Key-Concepts-and-Principles.pdf

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Master of Science
Course Code: ESM503-5C
Course Name: Environmental Science Practical-III
Semester: III

w.e.f.: July 2026

Type of Course: Major course

Prerequisite: Should have a Basic knowledge of ecology, environmental science fundamentals, and elementary laboratory and data analysis skills.

Rationale: At the end of the course, students will understand environmental processes through field and laboratory studies. They will develop skills in data collection, analysis, and interpretation for environmental assessment. They will also gain awareness and the ability to apply sustainable practices and environmental management.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
L	T	P	C	CCE Marks	SEE Marks	
-	-	12	6	75	75	150

Contents:

Sr. No.	Content	Total Hrs. 120
	1. Study of microbial role in biodegradation (organic waste decomposition) 2. Analysis of community structure in a terrestrial ecosystem. 3. Study of interspecific interactions (competition, predation- field observation). 4. Estimation of soil organic carbon (C cycle study). 5. Estimation of available phosphorus in soil. 6. Field survey and documentation of plant biodiversity. 7. Measurement of primary productivity (light and dark bottle method). 8. Study of ecosystem resilience using disturbance analysis (case study/field data). 9. Assessment of conservation status using IUCN categories (case study). 10. Study of restoration ecology practices (field visit/report). 11. Preparation of environmental risk assessment report (case study).	**120**

	12. Collection and preservation of water samples for analysis. 13. Quality assurance and quality control (QA/QC) procedures in environmental analysis. 14. Separation of compounds using paper chromatography. 15. Introduction to remote/automated monitoring systems (case study or software-based). 16. Analysis of long-term temperature data (trend analysis). 17. Study of rainfall variability using historical data. 18. Study of greenhouse gas emissions and sources. 19. Case study on climate-induced ecosystem disturbances (e.g., drought, floods). 20. Preparation of a basic Environmental Impact Assessment (EIA) report 21. Strategic Environmental Assessment (SEA) case study analysis. 22. Separation and identification of pesticides using Thin Layer Chromatography. 23. Identification and quantification of volatile organic compounds (VOCs) or pesticides in environmental samples using Gas Chromatography (GC). 24. Measurement of pH and electrical conductivity in water and soil samples using pH and conductivity meter respectively. 25. Detection and quantification of trace metals (e.g., Pb, Cd, Hg, As) in soil and water using Atomic Absorption Spectroscopy (AAS). 26. Riverine Flooding and Watershed Management (case study or software-based).	

Reference Books:

1. Laboratory Manual of Department of Chemistry, UPL University of Sustainable Technology, Ankleshwar.
2. Odum, E. P., & Barrett, G. W. (2005). *Fundamentals of ecology* (5th ed.). Cengage Learning.
3. Krebs, C. J. (2016). *Ecology: The experimental analysis of distribution and abundance* (7th ed.). Pearson Education.
4. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (1993). Microbiology (5th ed.). McGraw-Hill Education.

5. Brady, N. C., & Weil, R. R. (2016). The nature and properties of soils (15th ed.). Pearson Education.
6. American Public Health Association (APHA). (2017). Standard methods for the examination of water and wastewater (23rd ed.). APHA.
7. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). Chemistry for environmental engineering and science (5th ed.). McGraw-Hill.
8. Manahan, S. E. (2017). Environmental chemistry (10th ed.). CRC Press.
9. Miller, G. T., & Spoolman, S. (2018). Environmental science (15th ed.). Cengage Learning.
10. Canter, L. W. (1996). Environmental impact assessment (2nd ed.). McGraw-Hill.
11. Richardson, D. M. (Ed.). (2012). Restoration ecology: The new frontier (2nd ed.). Wiley-Blackwell.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand ecological principles and ecosystem functioning.	10%
CO-2	Perform environmental sampling and laboratory analysis.	20%
CO-3	Analyze climatic and environmental data.	20%
CO-4	Evaluate environmental issues scientifically.	20%
CO-5	Apply environmental assessment tools for decision-making.	10%
CO-6	Apply conservation and monitoring for sustainable management.	20%

Distribution of Practical Marks

A Level	B Level	C Level	D Level
10	**15**	**15**	**10**

Legends:

A= Conduction of Practical

B= Regular Record Writing

C= Viva -Voce

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science

Course Code: ESR500-5C

Course Name: Research Project-I

Semester: III

w.e.f.: July 2026

Type of Course: Core course

Prerequisite: Basic knowledge of postgraduate Environmetal Science concepts, research methodology, and laboratory skills.

Rationale: The research project is designed to enhance the employability skills of students by providing hands-on experience in a specialized area of Environmetal Science. It enables students to integrate and apply theoretical knowledge acquired from various courses to address real-life scientific and industrial challenges. The project also exposes students to recent developments, advanced techniques, and research methodologies, fostering innovation, entrepreneurship, self-employment opportunities, and potential employment generation through the extension and application of project outcomes.

Teaching and Examination Scheme:

					Examination Marks				Total Marks
L	T	P	Total	Credits	Theory Marks		Practical Marks		
-	-	8	8	4	CCE (M)	SEE (E)	CCE (I)	SEE (V)	
					-	-	50	50	100

Content:

Sr. No.	Content	Total Hrs.
1	The 3rd semester of M.Sc. is required to undertake Research Project-I. There are two categories offered for Research Project-I, ss listed below: *1. University Defined Project (UDP)* *2. Industry Defined Project (IDP)* From the above two categories students have to select either of the one.	**120**

Note:*Assessment & evaluation of the research project-I in Semester-III will be carried out purely based on the literarure survey and proposal of the work. However, in semester-IV, assessment & evaluation of the research project-II will be carried out based on guideline and policy of the department.*

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Identify and formulate research problems through literature review.	10%
CO-2	Design and perform experiments using appropriate techniques.	20%
CO-3	Analyze and interpret experimental data scientifically.	10%
CO-4	Demonstrate independent research and critical thinking skills.	20%
CO-5	Communicate research outcomes through reports and presentations.	20%
CO-6	Follow ethical practices, safety norms, and sustainability principles in research.	20%

Reference:

1. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
2. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

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Teaching/Exam Scheme

M.Sc. Sem. IV

Sr. No.	Course Code	Category of course	Course title	Hour s Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	ESM504-5C	Major Course	Environmental Analytics & Applications	4	0	-	4	4	50	50	-	-	100
2	ESE500-5C	Minor Course	Research Methodology	2	0	-	2	2	-	-	25	25	50
3	ESR501-5C	Core Course	Research Project-II	-	-	32	32	16	-	-	200	200	400
			Total	6	0	32	38	22	50	50	225	225	550

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Master of Science
Course Code: ESM504-5C
Course Name: Environmental Analytics & Applications
Semester: IV

w.e.f.: July 2026

Type of Course: Major Course

Prerequisite: Should have Fundamentals of Environmental Science, Pollution Control, Statistics, and computer applications.

Rationale: At the end of the course, the students should be able to develop fundamental and applied understanding of environmental science in industrial and infrastructure sectors by integrating pollution monitoring, sustainability practices, environmental management systems, statistical analysis, modelling, and AI/ML tools. It develops professional competencies required for environmental assessment, regulatory compliance, data-driven decision making, and sustainable industrial development.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	0	-	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Environmental Analytics** Concept and scope of environmental analytics, Types of environmental data: spatial, temporal and experimental, Data sources: field monitoring, sensors, remote sensing and databases, Environmental indicators and indices, Data quality, validation and uncertainty.	9
2	**Environmental Data Management** Data collection and organization, Sampling design and monitoring networks, Data cleaning, normalization and standardization, Database management systems, Environmental data visualization techniques.	9
3	**Statistical Methods in Environmental Analysis**	12

	Descriptive statistics and probability concepts, Correlation and regression analysis, Time-series analysis in environmental data, Multivariate analysis techniques, Trend analysis and environmental forecasting.	
SECTION - B		
4	**Geospatial and Remote Sensing Applications** Fundamentals of Geographic Information System (GIS), GIS data for assessing, mapping, and optimizing the logistics of biomass resources including tapping with its applications, Spatial data analysis and mapping, Case studies on use of GIS. Remote sensing principles and platforms, Land use/land cover analysis, Applications in environmental monitoring and resource management.	**12**
5	**Environmental Modeling and Decision Support** Environmental modeling concepts, Air and water quality modeling basics, Risk assessment models, Decision Support Systems (DSS), Predictive analytics for environmental management.	**9**
6	**Applications of Environmental Analytics** Climate change analysis and environmental assessment, Pollution monitoring and control strategies, Biodiversity conservation planning, Smart cities and sustainable infrastructure, Environmental impact assessment using analytical tools.	**9**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**20**	**15**	**15**

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

Text Books:

1. Susan Masten, Principles of Environmental Engineering and Science, ISBN: 9781260048889, Mcgraw-hill, 2019.
2. Kenneth Wark, Cecil Francis Warner, Air Pollution: Its Origin and Control, Lep Publishers, 1976.
3. Robert H. Shumway, David S. Stoffer, Time Series Analysis and Its Applications, ISBN:

9780387362762, Springer New York, 2006.

4. William Cyrus Navidi, Principles of Statistics for Engineers and Scientists, ISBN: 9781260257816, McGraw-Hill Education, 2020.
5. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor, An Introduction to Statistical Learning, ISBN: 9783031387470, Springer International Publishing, 2023.

Reference Books:

1. Masters, G.M., Introduction to Environmental Engineering and Science, ISBN 9789332549760, Pearson Education, 2015.
2. Mackenzie Leo Davis, Susan J. Masten, Principles of Environmental Engineering and Science, ISBN- 9780072921861, McGraw-Hill Higher Education, 2004
3. Bryan F.J. Manly, Statistics for Environmental Science and Management, 2nd Edition, ISBN- 978-1-4398-7812-5, CRC Press, 2008.
4. Richard Arnold Johnson, Dean W. Wichern, Applied Multivariate Statistical Analysis, 6th Edition, ISBN: 9780131877153, 2007.
5. John Wainwright, Mark Mulligan, Environmental Modelling, ISBN: 9780470091548, Wiley Publication, 2005.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain principles and scope of environmental analytics and data systems.	20%
CO-2	Manage and organize environmental datasets using appropriate methods.	15%
CO-3	Apply statistical techniques for environmental data analysis and interpretation.	15%
CO-4	Utilize GIS and remote sensing tools for environmental assessment.	15%
CO-5	Develop environmental models and decision-support approaches.	15%
CO-6	Apply environmental analytics for solving real-world sustainability and management problems.	20%

List of Open Source Software/learning website:

1. Environmental Chemistry and Analysis- https://nptel.ac.in/courses/122106030

2. https://qgis.org
3. https://earthengine.google.com
4. https://www.r-project.org
5. https://www.python.org
6. https://www.youtube.com/@googleearth
7. https://irmat-ucan.com/library/admin/books_pdf/pdf_67a8db4a72c9c0.56486197.pdf
8. https://www.mimuw.edu.pl/~noble/courses/TimeSeries/RESOURCES/ShumwayStofferTimeSeries.pdf

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science
Course Code: ESE500-5C
Course Name: Research Methodology
Semester: IV

w.e.f.: July 2026

Type of course: Minor Course

Prerequisite: Should have familiarity with scientific literature and research concepts.

Rationale: At the end of the course, tt provides students with a clear understanding of research concepts, scientific methods, problem identification, hypothesis formulation, research design, sampling techniques, and data analysis using appropriate statistical and software tools. The course also emphasizes interpretation of results, scientific writing, publication ethics, and responsible research practices, thereby preparing students to conduct independent research, critically evaluate scientific literature, and effectively communicate research findings in academic and professional environments.

Teaching and Examination Scheme:

					Examination Marks				Total Marks
L	T	P	Total	Credits	Theory Marks		Practical Marks		
2	-	-	2	2	CCE (M)	SEE (E)	CCE (I)	SEE (V)	
					-	-	25	25	50

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Foundations of research** Meaning, objectives, motivation, utility. concept of theory, empiricism, deductive and inductive theory. characteristics of scientific method- understanding the language of research- concept, construct, definition, variable. research process.	**8**
2	**Problem identification & formulation** Research question, investigation question, measurement issues, hypothesis, qualities of a good hypothesis, null hypothesis & alternative hypothesis.	**7**

	hypothesis testing - logic & importance. Research design- Concept and importance in research – features of a good research design- exploratory research design- concept, types and uses, descriptive research designs – concept, types and uses. experimental design: concept of independent & dependent variables.	
	SECTION - B	
3	**Sampling & Data analysis** Concepts of statistical population, sample, sampling frame, sampling error, sample size, non response. characteristics of a good sample. probability sample – simple random sample, systematic sample, stratified random sample & multi-stage sampling. determining size of the sample- practical considerations in sampling and sample size. Data analysis**:** Data preparation - univariate analysis (frequency tables, bar charts, pie charts, percentages), bivariate analysis - cross tabulations and chi-square test including testing hypothesis of association. uses of various software tools for chemistry.	**7**
4	**Interpretation of data and paper writing** Layout of a research paper, journals in chemistry, impact factor of journals, when and where to publish? ethical issues related to publishing, plagiarism and self-plagiarism. Ethical uses of AI/ ChatGPT, merits, demerits and limitations of AI. How research data is driven and available in public domain.	**8**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**20**	**15**	**15**

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

Text Books:

1. Donald Cooper & Pamela Schindler, Research Methods, 9th edition, Tata McGraw-Hill (TMGH), ISBN: 978-0073214870, 2006.
2. Alan Bryman & Emma Bell, Business Research Methods , Oxford University Press, 5th Edition, ISBN: 979-0-19-254590-9, 2019.

3. P.L. Bhandarkar, T.S. Wilkinson. Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai, ISBN-978-9350974728, 2016.
4. Panneerselvam. R. Research Methodology, Prentice Hall of India, New Delhi, 2nd Edition, ISBN: 9788120349469, 2004.
5. Green, P.E., Research for Marketing Decisions, Prentice-Hall of India, New Delhi, 3rd Edition, ISBN: 978-8120307575, 1994.

Reference Books:

1. Young, P.V., Scientific Social Survey and Research, Prentice-Hall sociology series, 2nd Edition, ISBN: 9788120300859, 1949.
2. Kothari.C.R. Research Methodology - Methods & Technology, New Age International Publisher, New Delhi, 4th Edition, ISBN- 978-81-224-2488-1, 2019.
3. Gupta, S.P. Statistical Methods, Sultan Chand and sons, 9788125916543, 9351611760, ISSN: 9351611760, 1999.
4. C. B. Gupta & Vijay Gupta, An introduction to Statistics Methods, Vikas Publishing House, ISBN: 9788125916543, 1998.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand research fundamentals, scientific methods, and hypothesis formulation.	15%
CO-2	Design research methodologies using appropriate designs and sampling techniques.	20%
CO-3	Apply statistical tools and software for data analysis and interpretation.	20%
CO-4	Communicate research findings effectively through scientific writing and publications.	15%
CO-5	Practice research ethics, plagiarism awareness, and responsible research conduct.	15%
CO-6	Apply ethical research practices supporting sustainability principles.	15%

List of Open Source Software/learning website:

1. NPTEL - https://onlinecourses.nptel.ac.in/noc26_ge43/preview
2. https://www.library.qmul.ac.uk/subject-guides/chemistry/useful-websites/
3. https://blog.feedspot.com/chemistry_websites/
4. https://egyankosh.ac.in/bitstream/123456789/85257/3/Unit-2.pdf
5. https://egyankosh.ac.in/bitstream/123456789/73586/3/Unit-7.pdf
6. https://egyankosh.ac.in/bitstream/123456789/118467/1/Unit-1.pdf
7. https://egyankosh.ac.in/bitstream/123456789/8380/1/Unit-10.pdf

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Master of Science
Course Code: ESR501-5C
Course Name: Research Project-II
Semester: IV

w.e.f.: July 2026

Type of Course: Core course

Prerequisite: Basic knowledge of Environmetal Science concepts, research methodology, and laboratory skills.

Rationale: The research project is designed to enhance the employability skills of students by providing hands-on experience in a specialized area of Environmetal Science. It enables students to integrate and apply theoretical knowledge acquired from various courses to address real-life scientific and industrial challenges. The project also exposes students to recent developments, advanced techniques, and research methodologies, fostering innovation, entrepreneurship, self-employment opportunities, and potential employment generation through the extension and application of project outcomes.

Teaching and Examination Scheme:

					Examination Marks				Total Marks
L	T	P	Total	Credits	Theory Marks		Practical Marks		
-	-	32	32	16	CCE (M)	SEE (E)	CCE (I)	SEE (V)	
					-	-	200	200	400

Content:

Sr. No.	Content	Total Hrs.
1	The 4th semester of M.Sc. is required to undertake Research Project-II. There are two categories offered for Research Project-II, ss listed below: *1. University Defined Project (UDP)* *2. Industry Defined Project (IDP)* From the above two categories students have to select either of the one.	**480**

Note:* *Assessment & evaluation of the research project-II in Semester-IV will be carried out based Review-I, II and III presentations of the research conducted, submission of 02 copies of embossed bound project thesis and open viva-voce examination.*

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Identify and formulate research problems through literature review.	10%
CO-2	Design and perform experiments using appropriate techniques.	20%
CO-3	Analyze and interpret experimental data scientifically.	10%
CO-4	Demonstrate independent research and critical thinking skills.	20%
CO-5	Communicate research outcomes through reports and presentations.	20%
CO-6	Follow ethical practices, safety norms, and sustainability principles in research.	20%

Reference:

1. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
2. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf