



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS01	Remote Sensing and Geographic Information System	4-0-1	120	04

- Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CO1: Understand principles of remote sensing and electromagnetic radiation

CO2: Analyze remote sensing data and image classification techniques

CO3: Apply GIS concepts and spatial data handling techniques

CO4: Perform geospatial analysis using GIS tools

CO5: Evaluate data quality and spatial analysis methods

CO6: Integrate remote sensing and GIS for environmental applications and decision-making

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Remote Sensing: definition and scope; Electro-magnetic radiation: characteristics, interaction with matter and spectral regions. Active & Passive Sensors, Resolution: Spectral, Spatial, Radiometric & Temporal	Lectures, ICT tools, demonstrations	CO1, CO5
II	Image Classification & RS Applications: Elements of Visual Interpretation, Supervised and Unsupervised classifications, Satellite Imageries and its application in Environmental Monitoring, Coastal zone planning, Flood & Drought mapping, Urban sprawl monitoring	Case-based learning, research discussions, simulations	CO2
III	Geographic Information System: GIS – definition, terminology, Map and GIS, Components of GIS, Data types: Point, Line, Polygon / Area, Surface, Non-spatial Attribute Data, Topology, Basic Spatial Analysis, Georeferencing: Datum projection & Coordinate System, GPS-GIS unification	Problem-solving, data analysis, group learning	CO3, CO6
IV	Data Quality and Basic Spatial Analysis: Raster Models, Vector Models, Accuracy, Precision and Resolution, Consistency and Completeness, Error Sources, Queries, Measurement, Classification, Symbolization, Union, Intersection, Data Merging	Case studies, presentations, experiential learning	CO4, CO6

- (* Learning Pedagogies/Methods)**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- (a) Seminars (Student-led and Faculty-moderated)
- (b) Micro-Projects/Mini Research Tasks
- (c) Industrial Visit/Field Visit/Institutional Visit
- (d) Problem-Based Learning (PBL)
- (e) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (f) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (g) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (h) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (i) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (j) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)
- **Assessment Methodologies**
 - (A) **Internal Assessment**
 - a. **Internal Formative assessment (30)**
 - (a) Quiz
 - (b) Assignment
 - (c) Seminar/Presentation
 - (d) Group Task
 - (e) Attendance
 - b. **Internal Summative Assessment (20)**
 - (a) Mid-Term
 - (b) External Assessment (50)
 - (c) End-Term

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/Analyse & above (A)	
I	CO1, CO5	30	1	1	12	14
II	CO2	32	1	1	10	12
III	CO3, CO6	28	1	1	10	12
IV	CO4, CO6	30	1	1	12	14
		120	04	04	34	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

(B) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	0	0	0	0	0	0	0	0
CLO2	3	3	2	0	0	0	0	0	2	0
CLO3	3	3	3	2	0	0	0	0	2	0
CLO4	3	2	0	3	2	0	0	0	0	2
CLO5	3	2	0	3	3	2	0	0	0	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Concepts and Techniques of Geographic Information Systems	C. P. Lo, Albert K. W. Yeung	—	PHI
2	Fundamentals of Geographic Information System	Michael N. DeMers	—	Wiley
3	Fundamentals of Remote Sensing	George Joseph	—	University Press
4	Geographical Information Systems: Principles, Techniques, Management & Applications	Paul A. Longley; Michael F. Goodchild; David J. Maguire; David W. Rhind	—	John Wiley & Sons Inc.
5	Global Navigation Satellite Systems	B. Bhatta	—	B S Publications
6	Global Positioning System: Signals, Measurements & Performance	Pratap Misra; Per Enge	—	—
7	GPS Satellite Surveying	Alfred Leick	—	Wiley
8	Remote Sensing & Image Interpretation	Lillesand; Kiefer; Chipman	—	Wiley



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	National Programme on Technology Enhanced Learning (NPTEL) – Remote Sensing & GIS Courses	https://nptel.ac.in
2	United States Geological Survey – Satellite data & GIS resources	https://www.usgs.gov
3	National Aeronautics and Space Administration – Remote sensing data & tutorials	https://www.nasa.gov
4	European Space Agency – Earth observation data	https://www.esa.int



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS02	Water Pollution and Control Technology	4-0-1	120	04

- Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Explain sources, characteristics, and demand of water in environmental systems.

CLO2: Describe groundwater systems, aquifers, and conservation techniques.

CLO3: Analyze conventional water treatment processes and operational principles.

CLO4: Evaluate advanced water treatment technologies and their applications.

CLO5: Assess water quality parameters, standards, and monitoring techniques.

CLO6: Apply appropriate water treatment and pollution control strategies in real-world scenarios.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Supply of water: Sources of water and their characteristics: water from precipitation (Strom water), surface water, and ground water. Water Quantity: Water and Its Properties, Necessity of Water, Water Demand, Factor Affecting Water Demand, Population Forecast by Different Methods. Sampling, sample preservation, physical characteristics, chemical characteristics and biological characteristics, drinking water standards.	Lectures, ICT tools, demonstrations	CO1, CO5
II	Groundwater: Introduction, types of aquifers, means to draw groundwater, Ground water conservation, seepage from surface water, artificial recharge, saline water intrusion - Causes and remedies of saline intrusion. Harmful effects of Modern Agricultural Practices: Soil erosion, Loss of Biodiversity, Climate Change, Chemical contamination, Air & Water Pollution, & its effect on Human health.	Case-based learning, research discussions, simulations	CO2
III	Water treatment: Conventional water treatment process, Screening, chemical handling and feeding, coagulation and flocculation, sedimentation, Filtration, Theory of filtration, filtration slow sand, rapid sand and pressure, filters. Disinfection; Criteria	Problem-solving, data analysis, group learning	CO3, CO6



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

IV	Advanced water treatments – membrane technology; Microfiltration, Ultrafiltration, Nanofiltration Reverse Osmosis, Other treatment technologies: Ion Exchange, Water Softening, Adsorption, Electrodialysis. Sustainable Agriculture: Indigenous practices: crop rotation, soil and water management, role of biodiversity in traditional farming.	Case studies, presentations, experiential learning	CO4, CO6
----	--	--	----------

- (*) **Learning Pedagogies/Methods**

Notes:

(3) The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.

(4) Acronyms/abbreviations of the terms can be placed in the above table.

(n) Interactive Classroom Lecture

(o) Classroom Lecture (CL)

(p) Seminars (Student-led and Faculty-moderated)

(q) Micro-Projects/Mini Research Tasks

(r) Industrial Visit/Field Visit/Institutional Visit

(s) Problem-Based Learning (PBL)

(t) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(u) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(v) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(w) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(x) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping) (aa) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) **Internal Assessment**

a. **Internal Formative assessment (20)**

(a) Mid-term tests

(b) Assignment, Self-learning and Terms work

(c) Seminar/Presentation

(d) Quiz

b. **Internal Summative Assessment (30)**

(a) End of Term Examination

(b) Laboratory performance

(c) Viva-voce



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1, CO5	30	1	1	12	14
II	CO2	32	1	1	10	12
III	CO3, CO6	28	1	1	10	12
IV	CO4, CO6	30	1	1	12	14
		120	04	04	34	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

(E) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	–	–	–	–	–	2	1
CLO2	2	2	2	1	–	–	–	–	2	2
CLO3	2	3	3	2	1	–	–	–	3	2
CLO4	2	2	3	3	2	1	–	–	3	2
CLO5	2	2	2	3	2	2	1	–	3	3
CLO6	2	3	2	3	2	2	2	1	3	3

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Treatment of Industrial Wastes	E. Besselviere; Schwartz	1975	McGraw Hill
2	Water Supply and Sanitary Engineering	G.S. Birdie	2002	Dhanpat Rai & Sons
3	Water and Wastewater Engineering (Vol. I & II)	G.M. Fair; T.C. Geyer; D.A. Okun	1984	John Wiley & Sons
4	Water and Sewage Treatment	S.K. Garg	2002	Blackwell Publishing
5	Pollution Control in Process Industries	Mahajan	1985	Tata McGraw Hill
6	Wastewater Engineering: Treatment, Disposal, Reuse	Metcalf & Eddy Inc.	1979	Tata McGraw Hill
7	Water Pollution Microbiology	Ralph Mitchell	1978	Wiley & Sons
8	Liquid Wastes of Industry: Theories, Practices and Treatment	N.L. Nemerow	1971	Addison Wesley
9	Environmental Engineering	Peavy; Row; Tchobanoglous	—	McGraw Hill (International ed.)
10	Physico-Chemical Processes for Water Quality Control	W.J. Weber	1969	Wiley Interscience

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	CPCB Water Quality Standards and Guidelines	https://cpcb.nic.in
2	WHO Guidelines for Drinking Water Quality	https://www.who.int
3	US EPA Water Treatment and Pollution Control Resources	https://www.epa.gov
4	NPTEL Courses on Water Treatment and Environmental Engineering	https://nptel.ac.in



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS03	Environmental Toxicology and Occupational Health	4-0-1	120	04

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Explain the structure and functions of human organs and their response to toxic substances.

CLO2: Describe mechanisms of toxicity including herbicides, heavy metals, and persistent pollutants.

CLO3: Analyze biochemical and physiological processes affected by environmental toxicants. **CLO4:** Evaluate occupational hazards, exposure pathways, and toxicological parameters.

CLO5: Assess occupational health risks and monitoring strategies in industrial environments. **CLO6:** Apply principles of ergonomics, safety, and health management in workplace settings.

Unit	Course Content	Learning Pedagogies*	CO(s)
I	Basic structure: Human tissue, skin, blood, kidney, lungs, heart, liver - , dermal, Nephro , cardiac, pulmonary toxicity and hepatic toxicity. Basic structure of Nervous system, ear and eye and their toxicity due to environmental pollutants: Neuron toxicity and ophthalmic toxicity. Respiration (ATP synthesis, biological oxidation) Glycolysis, Kreb's Cycle, Electron transport Chain, photosynthesis- Structure of Chlorophylls, photosystems, pigment systems, light reaction, C3, C4 Plants, CAM metabolism, environmental factors governing this process.	Lectures, ICT tools, demonstrations	CO1, CO3
II	Mode of action of herbicide- absorption, translocation, biochemical fate, metabolic response, morphological variations of herbs in general. Herbicide toxicology- classification and mode of action of urea, phenoxy, triazine substituted herbicides. Heavy metal toxicity- Mode of action of Lead, Mercury, Chromium and Cadmium and their impact on plants and animals including human organs. Teratogenicity and carcinogenicity, Persistent Organic Pollutants (POPs): Chemistry, distribution, long range transformation at Global level.	Case-based learning, research discussions, simulations	CO2, CO3



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

III	Introduction to Occupational pollutants: Classification of Hazardous Substances, types of effects and entry, preventive measures, industrial cancer-causing agents and substances and process causing occupational diseases. Toxicology- Acute and chronic toxicity, LC 50, LD50 Dose and Response, ADME.	Problem-solving, data analysis, group learning	CO3, CO4
IV	Recognition and evaluation of occupational health hazards, exposure assessment (Qualitative and quantitative), types of monitoring-air, workplace area, personal exposure. Physiology of work, assessment of workload, assessment of work capacity, nutrition, diets, physical fitness and their relationship, Ergonomics-principles, major heads, muscular physiology, work station design. Occupational Health Hazards in specific industries like Power plants, Textile mills, Cement industries, chemical and pharmaceutical, Petrochemical industries, coal mines etc.	Case studies, presentations, experiential learning	CO5, CO6

- **(* Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Classroom Lecture (CL)
- (b) Seminars (Student-led and Faculty-moderated)
- (c) Case-Based Learning (CBL)
- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice- based Tasks)
- (j) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (k) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (l) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (m) Inquiry-Based Learning
- (n) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

(A) Internal Assessment

a. Internal Formative assessment (30)

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

b. Internal Summative Assessment (20)

- (a) Mid-Term
- (b) External Assessment (50)
- (c) End-Term

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1, CO3	30	1	1	12	14
II	CO2, CO3	32	1	1	10	12
III	CO3, CO4	28	1	1	10	12
IV	CO5, CO6	30	1	1	12	14
		120	04	04	34	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

• CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	–	–	–	–	–	2	1
CLO2	2	2	3	2	1	–	–	–	2	2
CLO3	2	3	3	2	1	–	–	–	3	2
CLO4	2	2	3	3	2	1	–	–	3	2
CLO5	2	2	2	3	3	2	1	–	3	3
CLO6	2	2	2	3	2	3	2	1	3	3

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Mode of Herbicides	Ashton; Crafts	—	Tata McGraw Hill
2	Environmental Toxicology	David A. Wright; Pamela Welbourn	2002	Cambridge University Press
3	Environmental Toxicology & Chemistry	Donald G. Crosby	1998	Oxford University Press
4	Mode of Action of Herbicides: Physiology	Floyd M. Ashton; Alden S. Crafts	1981	Wiley-Interscience
5	Introduction to Environmental Toxicology	W.G. Landis; Ming-Ho Yu	1998	Lewis Press
6	Casarett and Doull's Toxicology: The Basic Science of Poisons	M.O. Amdur; John Doull; Curtis B. Klaassen	4th Ed.	Pergamon Press
7	Toxicology: The Basic Science of Poisons	Mary O. Amdur; John Doull; Curtis D. Klaassen	1991	Pergamon Press
8	Fungicides in Plant Disease Control	Y.L. Nene; P.N. Thapliyal	—	—
9	Pesticides, Insecticides and Fungicides	NIIR Board	1998	NIIR
10	Environmental Toxicology	Pandey; Shukla	2001	Dominant Press
11	Principles of Anatomy and Physiology	Tortora; Grabowski	2003	John Wiley & Sons
12	Introduction to Toxicology	R.K. Trivedi	2000	—
13	Introduction to Environmental Toxicology	Wayne G. Landis; Ming-Ho Yu	2000	Lewis Publishers

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	WHO Occupational and Environmental Health Resources	https://www.who.int
2	US EPA Toxicology and Risk Assessment	https://www.epa.gov
3	ILO Occupational Safety and Health Portal	https://www.ilo.org
4	NIOSH Workplace Safety and Toxicology Resources	https://www.cdc.gov/niosh



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS04	Practicals based on Remote Sensing and Water Pollution	0-8-0	120	04

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Demonstrate the determination of basic physicochemical parameters of water such as pH, conductivity, turbidity, acidity, and alkalinity using standard laboratory methods.

CLO2: Analyze water quality by estimating solids (TS, TDS, TSS), hardness, and major ions including sulfate, phosphate, nitrate, chloride, and fluoride.

CLO3: Apply analytical techniques to quantify trace elements such as boron and iron in environmental samples.

CLO4: Interpret geographical data through the study of topographic maps, drainage patterns, and contour cross-sections.

CLO5: Utilize environmental software tools related to remote sensing for data analysis and environmental monitoring.

CLO6: Evaluate industrial wastewater treatment processes (ETP, CETP, STP) through field visits and prepare analytical reports based on observations.

Course Content	Learning Pedagogies*	CLO(s)
<ol style="list-style-type: none"> Determination of pH, conductivity and turbidity Determination of Acidity and Alkalinity Determination of solids-TS, TDS, TSS Determination of Hardness- Total Hardness, Ca Hardness and Mg Hardness Determination of sulfate Determination of phosphate Determination of Nitrate Study of topographic maps Study of drainage patterns and contour cross-sections Determination of Chloride and Residual Chlorine Determination of Fluoride Determination of Boron Determination of Iron Study of Environmental software related to Remote sensing Visit to various industry-ETP, CETP, STP prepare a report and submit at the time of university Exam. 	Demonstration-based, Laboratory Teaching, Hands-on Practical / Experimental Learning, Analytical Learning, Field-based Learning, Problem-solving, Software-based Learning, Application-based Learning	CO1 to CO6



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- (*) **Learning Pedagogies/Methods**

Notes:

- (1) The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.
- (2) Acronyms/abbreviations of the terms can be placed in the above table.
 - (a) Interactive Classroom Lecture
 - (b) Classroom Lecture (CL)
 - (c) Seminars (Student-led and Faculty-moderated)
 - (d) Micro-Projects/Mini Research Tasks
 - (e) Industrial Visit/Field Visit/Institutional Visit
 - (f) Problem-Based Learning (PBL)
 - (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
 - (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
 - (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice- based Tasks)
 - (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
 - (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
 - (l) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment (30)

- (a) Journal Evaluation
- (b) Method of working
- (c) Attendance

b. Internal Summative Assessment (20)

- (a) Mid-Term
- (b) Viva-Voce

(B) External Assessment (50)

(a) End-Term

(B) Weightage of Learning Efforts for External Assessment

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
CO1 to CO6	120	5	10	35	50
	120	5	10	35	50



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- CLOs – PLOs Matrix**

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	2	2	-	-	1	-	-	-
CLO2	3	2	3	3	1	-	2	-	-	-
CLO3	3	2	3	3	2	-	2	-	-	-
CLO4	3	2	3	3	2	-	2	-	-	-
CLO5	3	2	3	3	2	-	2	-	-	-
CLO6	2	2	3	3	2	2	3	2	1	1

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Standard Methods for the Examination of Water and Wastewater	APHA	23rd Edition, 2017	APHA
2	Environmental Chemistry	A.K. De	7th Edition, 2016	New Age International
3	Introduction to Environmental Engineering	Gilbert M. Masters	2nd Edition, 1991	Pearson
4	Principles of Environmental Engineering and Science	Mackenzie L. Davis	3rd Edition, 2019	McGraw Hill
5	Water Supply Engineering	B.C. Punmia	2nd Edition, 1998	Laxmi Publications
6	Environmental Science	Erach Bharucha	3rd Edition, 2013	Universities Press
7	Remote Sensing and Image Interpretation	Thomas M. Lillesand & Ralph W. Kiefer	7th Edition, 2015	Wiley
8	Fundamentals of Remote Sensing	Indian Space Research Organisation	2012	ISRO Publication



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Standard methods for water quality analysis (pH, turbidity, hardness, ions, solids)	https://www.standardmethods.org
2	Water quality guidelines and wastewater treatment (ETP, CETP, STP)	https://www.epa.gov/water-research
3	Environmental chemistry and analytical techniques (iron, boron, nitrate, phosphate)	https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health
4	Remote sensing and GIS tools for environmental monitoring and mapping	https://www.isro.gov.in/remote-sensing
5	Topographic maps, drainage patterns and geological data	https://www.usgs.gov



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS05	Practicals based on Environmental Toxicology and Meteorology	0-8-0	120	04

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Demonstrate understanding of environmental toxicology concepts through the study of toxicological models, bioassays, and LC₅₀ determination using suitable organisms.

CLO2: Apply knowledge of meteorological instruments to measure and interpret environmental parameters such as wind velocity, temperature, pressure, humidity, and sunshine duration.

CLO3: Analyze the effects of environmental pollutants (e.g., herbicides, heavy metals) on biological systems using experimental and analytical methods.

CLO4: Operate and interpret results from advanced analytical instruments such as UV-Visible Spectrophotometer, GC-MS, AAS, ICP-MS, ICP-OES, FTIR, XRD, and XRF.

CLO5: Utilize statistical tools and graphical techniques (mean, median, ANOVA, correlation, regression, etc.) for data analysis and interpretation.

CLO6: Apply environmental and ergonomic software tools to assess meteorological data and evaluate occupational health risks such as musculoskeletal disorders.

Course Content	Learning Pedagogies*	CLO(s)
1. Study various models related to environmental toxicology 2. Study of various acute toxicological bioassay 3. LC 50 determination by Eichhornia crassipes 4. Study of meteorological instruments- wind velocity by anemometer, atmospheric pressure by aneroid barometer, temperature by minimum and maximum thermometer, relative humidity by wet and dry thermometer, sunshine hour by sunshine recorder 5. Estimate effect of different herbicide concentrations on seed / shoot / root germination 6. Study of analytical and sophisticated instruments - UV-Visible Spectrophotometer, Flame Photometer, Gas Chromatography-Mass Spectrometry (GC-MS), Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), FTIR Spectrophotometer, CHNS Analyzer, X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF)	Demonstration-based, Laboratory Teaching, Hands-on Practical Experimental Learning, Analytical Learning, Instrumentation-based Learning, Software-based Learning, Statistical Analysis, Problem-solving, Application-based Learning	CO1 to CO6



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

7. Statistics - graphical representation of data (bar, column, compound, pie and scatter), frequency distribution (histogram, frequency polygon, ogive), central tendency, mean, median, mode, t- test, ANOVA, Chi square test, correlation, Regression		
8. Environmental software related to meteorology To evaluate musculoskeletal risk from workstation design Quantification of selected heavy metals by spectrophotometer method		

- **(*) Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice- based Tasks)
- (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (l) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

- (C) **Internal Assessment**

- a. **Internal Formative assessment (30)**

- (d) Journal Evaluation
 - (e) Method of working
 - (f) Attendance

- b. **Internal Summative Assessment (20)**

- (c) Mid-Term
 - (d) Viva-Voce

- (D) **External Assessment (50)**

- (b) **End-Term**



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

(B) Weightage of Learning Efforts for External Assessment

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
CO1 to CO6	120	5	10	35	50
	120	5	10	35	50

• CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	3	2	2	-	2	-	-	-
CLO2	3	2	3	3	1	-	2	-	-	-
CLO3	3	2	3	3	2	-	3	-	-	-
CLO4	3	3	3	3	2	-	2	1	-	-
CLO5	2	3	3	3	2	2	2	2	1	1
CLO6	2	3	3	3	2	2	3	2	1	1

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Principles and Methods of Toxicology	A. Wallace Hayes	6th Edition, 2014	CRC Press
2	Casarett and Doull's Toxicology: The Basic Science of Poisons	Curtis D. Klaassen	8th Edition, 2013	McGraw Hill
3	Instrumental Methods of Chemical Analysis	G.R. Chatwal & S.K. Anand	5th Edition, 2007	Himalaya Publishing
4	Environmental Chemistry	A.K. De	7th Edition, 2016	New Age International
5	Fundamentals of Analytical Chemistry	Douglas A. Skoog	9th Edition, 2013	Cengage Learning
6	Introduction to Environmental Engineering	Gilbert M. Masters	2nd Edition, 1991	Pearson



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

7	Statistical Methods	S.P. Gupta	43rd Edition, 2014	Sultan Chand
8	Meteorology Today	C. Donald Ahrens	10th Edition, 2012	Brooks/Cole

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	Environmental toxicology, bioassay methods, and LC ₅₀ studies	https://www.epa.gov/risk
2	Meteorological data, instruments, and environmental parameters (temperature, humidity, wind, pressure)	https://www.imd.gov.in
3	Analytical instruments (UV-Vis, GC-MS, AAS, ICP-MS, FTIR, XRD, XRF) and spectroscopy techniques	https://chem.libretexts.org
4	Statistical analysis tools (mean, median, ANOVA, regression, correlation)	https://www.statisticshowto.com
5	Environmental software tools, ergonomics, and occupational health assessment	https://www.cdc.gov/niosh



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCENS06	Environmental and Meteorological Instrumentation	2-0-1	60	02

- Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Explain the principles and functioning of meteorological instruments.

CLO2: Describe environmental monitoring instruments used for air, water, and soil analysis. **CLO3:** Analyze the working principles of analytical instruments used in environmental studies. **CLO4:** Evaluate modern spectroscopic and chromatographic techniques.

CLO5: Interpret microscopic and separation techniques for environmental applications. **CLO6:** Apply instrumentation knowledge for environmental monitoring and data analysis.

Unit	Course Content	Learning Pedagogies*	CO(s)
I	Meteorological instruments- Meteorology as a discipline. Meteorology and Environment. Meteorological observatory and meteorological instruments: Cup anemometer, wet and dry bulb thermometer, minimum and maximum thermometer and hygrometers, rain gauge. Sunshine recorder, aneroid barometer, Environmental monitoring and related Instruments- Sacchis disc, Soil samplers, Soil leachate collectors. Water and sediment samplers. Soil tensiometer. Soil gas samplers, high volume air sampler and other air samplers – stack monitoring, and its working, applications	Lectures, ICT tools, problem-solving exercises	CO1, CO2
II	Analytical Instruments- U.V.-Visible and IR Spectrophotometer, Atomic Absorption spectrophotometer, Flame photometer, Bomb calorimeter, TOC analyzer, ICPAES, ICPMS, NMR., LCMS, Electrophoresis, Centrifuge. Chromatography- Paper, thin layer, HPLC, GCMS, GLC, Microscopy- Light microscope, Dark field, Bright field, Phase contrast, Electron microscope - SEM, TEM (Principle, ray diagram/figure, various important parts in brief and applications).	Lectures, ICT tools, problem-solving exercises	CO3, CO4, CO5, CO6

- (* Learning Pedagogies/Methods**

Notes:

- The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.
- Acronyms/abbreviations of the terms can be placed in the above table.



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- (a) Classroom Lecture (CL)
- (b) Seminars (Student-led and Faculty-moderated)
- (c) Micro-Projects/Mini Research Tasks
- (d) Industrial Visit/Field Visit/Institutional Visit
- (e) Problem-Based Learning (PBL)
- (f) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (g) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (h) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (i) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (j) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (k) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment (15)

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance

b. Internal Summative Assessment (10)

- (a) Mid-Term
- (b) External Assessment (25)
- (c) End-Term

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1, CO2	6	3	7	14	24
II	CO3, CO4, CO5, CO6	8	2	8	16	26
		60 2hrs/week	5	15	30	50



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

- CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	–	–	–	–	–	2	1
CLO2	2	3	2	1	–	–	–	–	3	2
CLO3	2	2	3	2	1	–	–	–	2	2
CLO4	2	2	3	3	2	1	–	–	3	2
CLO5	2	2	2	3	2	2	1	–	3	3
CLO6	2	3	2	3	2	2	2	1	3	3

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Biostatistics	Arora; Malhan	2000	Scientific Publishing
2	Fundamentals of Biostatistics	M.S. Negi	2002	Enviro Publication
3	Instrumental Analysis	Scoorg et al.	2000	Blackwell Publishing
4	Environmental Science	A. Turk; J. Turk; J.T. Wittes; R.E. Wittes	1978	W.B. Saunders Company
5	Principles of Environmental Sciences	K.E.F. Watt	1973	McGraw Hill
6	Instrumental Methods of Analysis	H.H. Willard; L.L. Merritt; J.A. Dean	1976 (5th ed.)	Van Nostrand Reinhold



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Environmental Science SEMESTER II

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	World Meteorological Organization (WMO) Resources	https://public.wmo.int
2	US EPA Environmental Monitoring Tools	https://www.epa.gov
3	NPTEL Analytical Instrumentation Courses	https://nptel.ac.in
4	NASA Earth Observation and Atmospheric Data	https://earthdata.nasa.gov