

**KRANTIGURU SHYAMJI KRISHNA VERMA
KACHCHH UNIVERSITY, BHUJ**

Academic Year: 2026-2027



**Syllabus (NEP – 2020)
B.Sc. (Honours) ENVIRONMENT SCIENCE
(with Research /without Research)**

**Semesters: VII and VIII
(with Multiple exit-entry options)**

FACULTY OF SCIENCE

**A Curriculum of Environment Science
Faculty of Science framed as per UGC Guidelines and norms of
National Education Policy (NEP) – 2020.**

With effect from June – 2026



AIM OF THE COURSE:

Aims of the B.Sc. (Honours) Course in Environment Science:

- Foster a hands-on learning approach that encourages students to explore and discover the wonders of environment science.
- Embrace modern educational trends like e-learning, flipped classrooms, and hybrid learning to create an engaging and interactive learning environment.
- Cultivate environmentally responsible citizens who play a pivotal role in shaping the future of marine science subject and contribute their knowledge to sustainable development.
- Provide comprehensive theoretical and practical knowledge in Environment Science, equipping graduates with the necessary skills for further studies or exciting careers in marine-related fields.
- Prepare students for national and international competitive examinations, empowering them to pursue advanced research opportunities or secure prestigious positions in environment science and related fields.



COURSE INTRODUCTION

The new curriculum of B.Sc. in Science (Environment Science) offers the essential knowledge and technical skills to study environment science in a holistic manner. Students would be trained in all areas of environment science using a unique combination of Major, Minor, MDC, AEC, SEC and VAC papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently being used in the study of environment science and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of subject and its relevance to the national economy. B.Sc. Environment Science Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities, and projects would also be organized for real-life experience and learning. Candidates who have curiosity in the field of Environment, Nature, Ecosystems and eager to exploring various exotic places, and wish to work as researchers or professionals like Marine Scientists, conservationists, Ecologists, etc. can choose the B.Sc. Environment Science course.



Programme outcomes (POs)

This curriculum in B.Sc. Environment Science aims to cultivate well-rounded individuals who are not only equipped with knowledge in the field of environment science but are also driven to contribute to their nation's progress and shape the future. By studying environment science, students will develop a deep understanding of the ecosystem, environmental pollutions and its potential for transformative impact on various sectors.



EVALUATION METHODS:

Evaluation Methods for Environment Science: To assess the achievement of students in the Environment Science subject and ensure their desired learning outcomes, a variety of assessment methods will be adopted. These methods will provide a comprehensive evaluation of the student's academic performance. Here are the innovative assessment methods for Environment Science:

1. **Engaging Examinations:** Both oral and written examinations, including scheduled and surprise tests, will be conducted. These exams will test students' theoretical knowledge, critical thinking, and problem-solving skills related to environment science concepts.
2. **Diverse Testing Approaches:** Closed-book and open-book tests will be administered to assess students' understanding and application of marine science principles. These tests will challenge their ability to think critically and apply concepts to real-world scenarios.
3. **Practical Assignments and Reports:** Students will be assigned practical assignments and laboratory reports to evaluate their hands-on skills and understanding of environment science experiments and techniques. These assignments will provide insight into their ability to collect, analyze, and interpret data in the context of fields of environment science.
4. **Observation of Practical Skills:** Practical skills, such as field sampling techniques or data collection methods, will be directly observed and evaluated. This assessment method allows instructors to assess students' competency in executing practical tasks related to environment science.
5. **Collaborative Projects:** Both individual and group project reports will be assigned to encourage collaborative learning and foster teamwork. These projects will assess students' ability to conduct research, analyze data, and present findings on various environment science topics.



6. **Innovative Seminar Presentations:** Students will deliver seminar presentations on specific environment science subjects. This method will not only test their understanding and communication skills but also encourage them to explore cutting-edge research and advancements in the field.

7. **Viva Voce Interviews:** Viva voce interviews will be conducted to assess students' comprehensive understanding of marine science concepts and their ability to articulate their knowledge effectively. This interactive assessment method will provide insights into their depth of understanding and critical thinking skills.

8. **Computerized Adaptive Testing:** Utilizing computerized adaptive testing methods will enable personalized assessment and help identify individual learning needs. These tests can adapt the difficulty level based on the student's responses, ensuring a tailored evaluation.

9. **Literature Surveys and Evaluations:** Students will be required to conduct literature surveys and evaluations on marine science topics. This assessment approach will develop their research skills, and ability to critically analyze scientific literature, and synthesize information from various sources.

10. **Comprehensive Continuous Assessment (CCA):** Students will undergo continuous assessment throughout the course, including internal evaluations. The weightage of CCA will be 30% of the overall evaluation, ensuring a holistic evaluation of their progress.

11. **End of Semester Examination:** The semester-end examination, comprising 70% of the evaluation, will assess students based on their knowledge, understanding, skills, application, and higher-order thinking skills related to environment science concepts. The assessment will be conducted by the university.

Additionally, to enhance their learning experience, students will be required to participate in at least one environment Science Excursion, where they will study ecosystems and



biodiversity in their natural state. Laboratory work must be recorded in certified journals, which will be presented during practical examinations to showcase the students' hands-on expertise.

These innovative and varied assessment methods will enable a comprehensive evaluation of student's knowledge, skills, and understanding of Environment Science, fostering their growth and development in this field.



Paper and Credit Scheme for Environment Science

For Environment Science Semester - VII

Year	Semester	Type of Paper	Paper Code	Paper Name	Credits	Marks		Total
						CA	UA	
Fourth Year	VII	Major – 1 Theory	MJES – 701 (Theory)	Fundamentals Of Earth And Environmental Systems	3	35	35	70
		Major – 1 Practical	MJES – 702 (Practical)	Fundamentals Of Earth And Environmental Systems	1	15	15	30
		Major – 2 Theory	MJES – 703 (Theory)	Ecosystems, Biogeochemistry And Microbial Ecology	3	35	35	70
		Major – 2 Practical	MJES – 704 (Practical)	Ecosystems, Biogeochemistry And Microbial Ecology	1	15	15	30
		Major – 3 Theory	MJES – 705 (Theory)	Fundamentals Of Environmental Analytical Techniques	3	35	35	70
		Major – 3 Practical	MJES – 706 (Practical)	Fundamentals Of Environmental Analytical Techniques	1	15	15	30
		Minor – 1 Theory	MNES – 707 (Theory)	Fundamentals Of Earth And Environmental Systems	3	35	35	70
		Minor – 1 Practical	MNES – 708 (Practical)	Fundamentals Of Earth And Environmental Systems	1	15	15	30
		Major Based Paper (instead of OJT)	Major – 4 Theory	MJES – 709 (Theory)	3	35	35	70
			Major – 4 Practical	MJES – 710 (Practical)	1	15	15	30
		SEC	SEC 700	Research methodology	2	25	25	50
			TOTAL		22	275	275	550



For Environment Science Semester - VIII

Year	Semester	Type of Paper	Paper Code	Paper Name	Credits	Marks		Total
						CA	UA	
Fourth Year	VII	Major – 1 Theory	MJES – 801 (Theory)	Fundamentals Of Earth And Environmental Systems	3	35	35	70
		Major – 1 Practical	MJES – 802 (Practical)	Fundamentals Of Earth And Environmental Systems	1	15	15	30
		Major – 2 Theory	MJES – 803 (Theory)	Ecosystems, Biogeochemistry And Microbial Ecology	3	35	35	70
		Major – 2 Practical	MJES – 804 (Practical)	Ecosystems, Biogeochemistry And Microbial Ecology	1	15	15	30
		Major – 3 Theory	MJES – 805 (Theory)	Fundamentals Of Environmental Analytical Techniques	3	35	35	70
		Major – 3 Practical	MJES – 806 (Practical)	Fundamentals Of Environmental Analytical Techniques	1	15	15	30
		Minor – 1 Theory	MNES – 807 (Theory)	Fundamentals Of Earth And Environmental Systems	3	35	35	70
		Minor – 1 Practical	MNES – 808 (Practical)	Fundamentals Of Earth And Environmental Systems	1	15	15	30
		Major Based Paper		On Job Training/ Dissertation	6	75	75	150
			TOTAL		22	275	275	550



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 7****CODE: MJES 701****PAPER NAME: FUNDAMENTALS OF EARTH AND ENVIRONMENTAL SYSTEMS****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 7 ENVIRONMENT SCIENCE MAJOR 1	NO. OF LECTURES
1	Earth System Science, Planetary Processes and Sustainability Frameworks • Structure and components of Earth: atmosphere, hydrosphere, lithosphere, biosphere • Origin and evolution of Earth, Earth system interactions and feedback mechanisms • Earth's energy budget and global circulation • Earth's climatic zones and biomes, Earth system processes and feedback mechanisms • Anthropocene and planetary boundaries concept • Introduction to Sustainable Development Goals (SDGs)	15
2	Atmospheric and Hydrological Systems under Changing Climate Atmospheric Systems: • Composition, structure and functions of the atmosphere, its chemistry and classification of elements. Reactions in lower and upper atmosphere • Atmospheric stability, inversions and mixing heights, Wind patterns and wind roses • Atmospheric aerosols and their environmental role • Urban Heat Island effect, Radioactivity in the atmosphere • Climate variability, extreme events and climate change Hydrological Systems: • Structure, properties and environmental significance of water • Distribution of water on Earth and global water balance, Freshwater chemistry and aquatic biogeochemical processes, Solubility of gases in water • Hydrological cycle under climate change, Cryosphere components (glaciers, snow, permafrost) and their role, Forms of precipitation: rain, snow, dew, mist and fog	15
3	Ocean, Lithosphere and Soil Systems: Processes and Resources Ocean Systems and Marine Chemistry: • Origin and evolution of oceans; plate tectonics and ocean basin formation • Major ocean floor features: continental shelf, slope, rise, abyssal plains, trenches, mid ocean ridges, Seafloor spreading, hydrothermal vents and chemosynthetic ecosystems, Properties and composition of seawater • Marine biogeochemistry: nutrient cycling, ocean-atmosphere carbon exchange, ocean acidification, Blue carbon ecosystems and carbon sequestration (marine and terrestrial), Marine mineral resources:	15



metallic and non-metallic (e.g., manganese nodules)

Lithosphere and Soil Systems: • Factors and processes of soil formation, Soil types, profiles, and classification • Physical and chemical properties of soils, Soil–water–climate interactions • Soil health indicators and assessment, Soil degradation: erosion, salinity, desertification



DETAILED SYLLABUS OF B.Sc. 4th YEAR

ENVIRONMENT SCIENCE

(PRACTICAL PAPER)

SEMESTER - 7

CODE: MJES 702

PAPER NAME: FUNDAMENTALS OF EARTH AND ENVIRONMENTAL SYSTEMS

KSKV Kachchh University, Bhuj - Kachchh

PRACTICAL	AIM OF PRACTICAL
1	To determine the pH and salinity status of soil samples collected from different locations
2	To study local wind direction and wind speed patterns.
3	To estimate physical and chemical characteristics of freshwater samples.
4	To determine water holding capacity and soil moisture percentage.
5	To assess atmospheric aerosols and air quality.
6	Demonstration of Earth's Energy Budget through charts, images and models.
7	Demonstration of Plate Tectonics and Seafloor Spreading through charts, images and models
8	Demonstration of Hydrological Cycle under Climate Change through charts, images and models
9	Demonstration of Urban Heat Island Effect through charts, images and models



Suggested Readings:

- Environmental Science by Erach Bharucha
- Fundamentals of Ecology by Eugene P. Odum
- Introduction to Environmental Engineering and Science by Gilbert M. Masters
- Environmental Chemistry by A.K. De
- Essentials of Oceanography by Alan P. Trujillo
- Soil Science by D.K. Das
- Meteorology Today by C. Donald Ahrens
- Environmental Studies by R. Rajagopalan
- Marine Ecology by Michael J. Kaiser
- Principles of Geology by Arthur Holmes



**DETAILED SYLLABUS OF B.Sc. 4th YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 7

CODE: MJES 704

**PAPER NAME: ECOSYSTEMS, BIOGEOCHEMISTRY AND MICROBIAL ECOLOGY
KSKV Kachchh University, Bhuj - Kachchh**

PRACTICAL	AIM OF PRACTICAL
1	To determine gross and net primary productivity of pond water using light and dark bottle method.
2	To estimate microbial abundance in soil samples.
3	Analysis of Food Chain and Food Web in Local Ecosystem.
4	Measurement of Species Diversity Using Shannon-Wiener Index
5	To demonstrate Nitrogen Fixing Microorganisms through charts, images and models.
6	Demonstration of Ecological Pyramids through charts, images and models.
7	Demonstration of Carbon and Nitrogen Cycles through charts, images and models.
8	To demonstrate stages of succession in terrestrial ecosystem through charts, images and models.
9	Demonstration of Population Growth Curves through charts, images and models.
10	To demonstrate interactions between soil microbes and plant roots through charts, images and models.



Suggested Readings:

- Fundamentals of Ecology by Eugene P. Odum
- Ecology and Environment by P.D. Sharma
- Environmental Biology by P.S. Verma and V.K. Agarwal
- Microbial Ecology by Larry L. Barton
- Textbook of Environmental Ecology by S.C. Santra
- Concepts of Ecology by Edward J. Kormondy
- Soil Microbiology by N.S. Subba Rao
- Biodiversity by Edward O. Wilson
- Environmental Studies by R. Rajagopalan
- Principles of Environmental Science by William P. Cunningham



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 7****CODE: MJES 705****PAPER NAME: FUNDAMENTALS OF ENVIRONMENTAL ANALYTICAL
TECHNIQUES****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 7 ENVIRONMENT SCIENCE MAJOR 3	NO. OF LECTURES
1	Fundamental Analytical Principles, Electrochemistry and Microscopy Analytical Fundamentals: • Concepts of accuracy, precision, sensitivity, and error, Calibration methods and quality assurance/quality control (QA/QC), Sampling strategies and sample preparation in environmental analysis • Electrochemical Techniques: Principles of electrochemistry, pH, buffers and their environmental significance, Potentiometric and conductometric methods and titrations • Microscopy and Imaging Techniques: Principles and applications of light microscopy, Phase contrast and fluorescence microscopy, Scanning and transmission electron microscopy (SEM, TEM) • Scanning tunneling microscopy (STM) and atomic force microscopy (AFM), Confocal microscopy, Cytophotometry and flow cytometry, Fixation and staining techniques Sensor Technologies: Principles of biosensors, Introduction to environmental sensing approaches	15
2	Separation, Filtration, Centrifugation and Chromatographic Techniques Separation Techniques: • Principles and applications of filtration, Centrifugation: basic principles and types (differential, density gradient, ultracentrifugation) Chromatographic Techniques: • Principles of chromatography and separation science • Thin layer chromatography (TLC), Gas chromatography (GC), High performance liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC), Ion exchange and affinity chromatography, Gel filtration chromatography, Electrophoresis techniques Advanced Analytical Techniques: • Inductively Coupled Plasma techniques: ICP-MS and ICP-OES (introduction and applications), Liquid chromatography-mass spectrometry (LC-MS/MS): principles and environmental applications	15
3	Spectroscopic Techniques, Environmental Monitoring and Data Analysis Spectroscopic Techniques: • Principles and applications of	15



UV-Visible spectroscopy, Infrared (IR) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Electron Spin Resonance (ESR) spectroscopy, X-ray diffraction (XRD) and X-ray fluorescence (XRF) Environmental Monitoring and Field Instrumentation: • Remote environmental sensing instruments, Basics of spectroradiometry, Environmental sensors and data loggers, Field-based environmental monitoring techniques Analytical Data Handling: Spectroscopic analysis of environmental samples, Basics of analytical data interpretation, Data reporting and presentation in environmental studies.	
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DETAILED SYLLABUS OF B.Sc. 4TH YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)
SEMESTER - 7
CODE: MJES 706
PAPER NAME: FUNDAMENTALS OF ENVIRONMENTAL ANALYTICAL
TECHNIQUES
KSKV Kachchh University, Bhuj - Kachchh

PRACTICAL	AIM OF PRACTICAL
1	To calibrate a pH meter using standard buffer solutions and determine pH of given samples.
2	To separate plant pigments using paper chromatography technique.
3	To separate suspended particles from water samples using centrifugation.
4	Demonstration of Light and Fluorescence Microscope with principles and applications through charts, images and models.
5	Demonstration of SEM and TEM Microscope with principles and applications through charts, images and models.
6	Demonstration of High Performance Liquid Chromatography (HPLC) through charts, images and models.
7	To demonstrate field-based environmental monitoring instruments.
8	Demonstration of Electrophoresis Technique through charts, images and models.



Suggested Readings:

- Instrumental Methods of Chemical Analysis by Gurdeep Raj Chatwal and Sham Anand
- Analytical Chemistry by Gary D. Christian
- Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker
- Environmental Chemistry by A.K. De
- Vogel's Textbook of Quantitative Chemical Analysis by G.H. Jeffery
- Fundamentals of Analytical Chemistry by Douglas A. Skoog
- Environmental Analytical Chemistry by F.W. Fifield and P.J. Haines
- Biophysical Chemistry by A. Upadhyay
- Practical Biochemistry by David Plummer
- Introduction to Spectroscopy by Donald L. Pavia



DETAILED SYLLABUS OF B.Sc. 4TH YEAR**SEMESTER - 7****CODE: MNES 707****PAPER NAME: FUNDAMENTALS OF EARTH AND ENVIRONMENTAL SYSTEMS****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 7 ENVIRONMENT SCIENCE MINOR 1	NO. OF LECTURES
1	Earth System Science, Planetary Processes and Sustainability Frameworks • Structure and components of Earth: atmosphere, hydrosphere, lithosphere, biosphere • Origin and evolution of Earth, Earth system interactions and feedback mechanisms • Earth's energy budget and global circulation • Earth's climatic zones and biomes, Earth system processes and feedback mechanisms • Anthropocene and planetary boundaries concept • Introduction to Sustainable Development Goals (SDGs)	15
2	Atmospheric and Hydrological Systems under Changing Climate Atmospheric Systems: • Composition, structure and functions of the atmosphere, its chemistry and classification of elements. Reactions in lower and upper atmosphere • Atmospheric stability, inversions and mixing heights, Wind patterns and wind roses • Atmospheric aerosols and their environmental role • Urban Heat Island effect, Radioactivity in the atmosphere • Climate variability, extreme events and climate change Hydrological Systems: • Structure, properties and environmental significance of water • Distribution of water on Earth and global water balance, Freshwater chemistry and aquatic biogeochemical processes, Solubility of gases in water • Hydrological cycle under climate change, Cryosphere components (glaciers, snow, permafrost) and their role, Forms of precipitation: rain, snow, dew, mist and fog	15
3	Ocean, Lithosphere and Soil Systems: Processes and Resources Ocean Systems and Marine Chemistry: • Origin and evolution of oceans; plate tectonics and ocean basin formation • Major ocean floor features: continental shelf, slope, rise, abyssal plains, trenches, mid ocean ridges, Seafloor spreading, hydrothermal vents and chemosynthetic ecosystems, Properties and composition of seawater • Marine biogeochemistry: nutrient cycling, ocean-atmosphere carbon exchange, ocean acidification, Blue carbon ecosystems and carbon sequestration (marine and terrestrial), Marine mineral resources: metallic and non-metallic (e.g., manganese	15



nodules)

Lithosphere and Soil Systems: • Factors and processes of soil formation, Soil types, profiles, and classification • Physical and chemical properties of soils, Soil–water–climate interactions • Soil health indicators and assessment, Soil degradation: erosion, salinity, desertification



**DETAILED SYLLABUS OF B.Sc. 4TH YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 7

CODE: MNES 708

**PAPER NAME: FUNDAMENTALS OF EARTH AND ENVIRONMENTAL SYSTEMS
KSKV Kachchh University, Bhuj – Kachchh**

PRACTICAL	AIM OF PRACTICAL
1	To determine the pH and salinity status of soil samples collected from different locations
2	To study local wind direction and wind speed patterns.
3	To estimate physical and chemical characteristics of freshwater samples.
4	To determine water holding capacity and soil moisture percentage.
5	To assess atmospheric aerosols and air quality.
6	Demonstration of Earth's Energy Budget through charts, images and models.
7	Demonstration of Plate Tectonics and Seafloor Spreading through charts, images and models
8	Demonstration of Hydrological Cycle under Climate Change through charts, images and models
9	Demonstration of Urban Heat Island Effect through charts, images and models



Suggested Readings:

- Environmental Science by Erach Bharucha
- Fundamentals of Ecology by Eugene P. Odum
- Introduction to Environmental Engineering and Science by Gilbert M. Masters
- Environmental Chemistry by A.K. De
- Essentials of Oceanography by Alan P. Trujillo
- Soil Science by D.K. Das
- Meteorology Today by C. Donald Ahrens
- Environmental Studies by R. Rajagopalan
- Marine Ecology by Michael J. Kaiser
- Principles of Geology by Arthur Holmes



DETAILED SYLLABUS OF B.Sc. 4TH YEAR**SEMESTER - 7****CODE: MJES 709****PAPER NAME: DRYLAND AND MARINE ENVIRONMENTAL SYSTEMS****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 7 ENVIRONMENT SCIENCE MAJOR	NO. OF LECTURES
1	Marine Environment, Ecology and Coastal Systems • Ocean as an ecosystem and classification of marine habitats, Marine environmental conditions: tides, temperature, wave action, salinity, nutrients and other factors • Adaptations of intertidal organisms (rocky, sandy, muddy shores): o Resistance to water loss, heat balance, mechanical stress o Respiration, feeding, salinity stress, reproduction o Distribution patterns, feeding biology, community organization and zonation • Important marine and coastal ecosystems: mangroves, coral reefs, mudflats, estuaries, lagoons, backwaters and brackish waters, Coastal and marine activities: ports, harbors, aquaculture, salt works and their ecological impacts • Marine Protected Areas (MPAs), Ocean acidification and coral bleaching, Blue Economy concept.	15
2	Dryland Systems and Desertification Processes • Definition of desertification and UNCCD framework, Genesis of the Convention to Combat Desertification (CCD), Status of drylands and desertification globally and in India, Climate and desertification: rainfall patterns, variability, and dryland climate (India-specific context) • Major causes of desertification: o Unsustainable agricultural practices and shifting cultivation, Unsustainable water management, Land-use changes, Deforestation and loss of vegetative cover, Industrial and mining activities, Drought and land degradation • Processes of desertification: o Soil erosion (wind and water), Salinity, alkalinity and waterlogging • Dryland agriculture and climate resilience • Carbon dynamics in arid and semi-arid ecosystems.	15
3	Impacts, Monitoring and Management of Desertification Impacts of Desertification: • Impact of population pressure on forest resources, Impacts on biodiversity and ecosystem services, Livestock pressure on grazing and forest lands, Depletion of vegetative cover, Soil degradation: wind and water erosion, fertility loss, Impacts of inefficient water management, Impacts on quality of life and livelihoods, Linkages with climate change	15



Management and Mitigation Strategies: • Policy, strategy and legislative frameworks (national and global), Environmental conservation strategies and institutional frameworks, Programmes and technologies for combating desertification (soil, water and vegetation conservation), National programmes: DDP, DPAP, IGNP • Traditional and indigenous technologies, Interlinking national efforts with regional and global initiatives, Nature-based solutions (NbS) for land restoration, Role of remote sensing and geospatial tools in desertification monitoring	
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**DETAILED SYLLABUS OF B.Sc. 4TH YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 7

CODE: MJES 710

**PAPER NAME: DRYLAND AND MARINE ENVIRONMENTAL SYSTEMS
KSKV Kachchh University, Bhuj - Kachchh**

PRACTICAL	AIM OF PRACTICAL
1	To estimate salinity and pH of marine or estuarine water samples.
2	To study distribution and zonation of intertidal organisms.
3	To determine soil organic carbon in dryland or coastal soils.
4	Assessment of Soil Texture and Water Holding Capacity of given soil samples.
5	To identify and document coastal vegetation diversity.
6	To demonstrate effects of climate change on coral ecosystems through charts, images and models.
7	Demonstration of Tidal Movements and Wave Action through charts, images and models.
8	To demonstrate processes of desertification and land degradation through charts, images and models.



Suggested Readings:

- Marine Ecology by Michael J. Kaiser
- Introduction to Marine Biology by George Karleskint
- Essentials of Oceanography by Alan P. Trujillo
- Coastal Ecosystems of the Tropics by U. C. Srivastava
- Environmental Studies by R. Rajagopalan
- Ecology and Environment by P.D. Sharma
- Soil Conservation and Land Management by G.S. Dhruvanarayana
- Desertification by D.K. Roy
- Remote Sensing and GIS by M. Anji Reddy
- Fundamentals of Ecology by Eugene P. Odum



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 8****CODE: MJES 801****PAPER NAME: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 8 ENVIRONMENT SCIENCE MAJOR 1	NO. OF LECTURES
1	Fundamentals of Pollution and Atmospheric Pollution Processes Definition, concepts and classification of pollution and pollutants, Types, origin, properties and sources of pollutants, Composition and structure of atmosphere, Primary and secondary air pollutants, Major air pollutants: PM _{2.5} , PM ₁₀ , VOCs, black carbon, methane, tropospheric ozone, Behavior, transport, transformation and fate of air pollutants in atmosphere, Photochemical smog and atmospheric reactions, Greenhouse gases, global warming and climate pollutants, Chlorofluorocarbons (CFCs) and ozone layer depletion, Carbon footprint and emission inventories, Indoor air pollution and associated health impacts, Air Quality Index (AQI): concept, calculation and interpretation, Atmospheric stability, lapse rates, wind systems, turbulence and plume behaviour, Dispersion of pollutants and Gaussian plume model (basic concept), Air pollution monitoring techniques and sampling methods, Continuous Ambient Air Quality Monitoring Systems (CAAQMS), Remote sensing applications in air pollution monitoring, Source apportionment studies, Air pollution control methods and equipment, Ambient air quality standards.	15
2	Unit II: Water, Marine and Thermal Pollution Introduction, definition, sources and types of water pollutants, Surface water and groundwater pollution, Physical, chemical and biological effects of water pollution, Wastewater treatment processes: preliminary, primary, secondary and tertiary treatment, Removal of suspended and dissolved solids, nitrogen and phosphorus, Advanced biological treatment systems and chemical oxidation processes, Resource recovery from process effluents and Water purification methods, Wastewater reuse and recycling technologies, Nature-based wastewater treatment systems (constructed wetlands), Marine pollution: sources and nature of pollutants, Oil spills and oil pollution, Heavy metals and metallic pollutants in marine systems, Coastal and estuarine pollution in India, Marine plastic pollution and	15



	microplastics, Emerging contaminants: pharmaceuticals and PFAS, Sea level rise: causes, impacts and control measures, Chemicals and drugs from oceans, Thermal pollution: concept, sources and impacts, Thermal power plant pollution, Effects of thermal pollution on water quality and marine life, Prevention and control of thermal pollution	
3	Unit III: Soil, Noise, Radiation and Solid Waste Pollution Management Soil Pollution: Sources, types and processes of soil pollution, Soil degradation and contamination, Soil pollution management and remediation, Integrated Pest Management (IPM) and Integrated Nutrient Management (INM), Land restoration approaches Noise Pollution: Characteristics and sources of noise pollution, Measurement and standards of noise as well as noise indices and numerics, Impacts of noise pollution on humans and environment, Noise control and mitigation measures Radiation Pollution: Sources and types of radiation pollution, Biological effects of radiation, Radiation safety and control measures Solid and Hazardous Waste Management: Municipal, industrial, biomedical and hazardous wastes, Waste handling, segregation and disposal methods, Waste treatment technologies: incineration, pyrolysis and composting, Resource recovery and circular economy approaches	15



**DETAILED SYLLABUS OF B.Sc. 4th YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 8

CODE: MJES 802

**PAPER NAME: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES
KSKV Kachchh University, Bhuj - Kachchh**

PRACTICAL	AIM OF PRACTICAL
1	Determination of physical characteristics of water: colour, turbidity, TDS, TSS, dissolved solids, acidity and alkalinity
2	Determination of Dissolved Oxygen (DO)
3	Determination of Biological Oxygen Demand (BOD)
4	Determination of Chemical Oxygen Demand (COD)
5	Estimation of chloride in water and soil samples
6	Determination of total calcium and magnesium
7	Determination of total nitrogen, phosphorus and organic carbon from environmental samples
8	Drinking water analysis using Membrane Filter Technique (MFT) for coliform detection
9	Soil salinity and nutrient assessment (advanced continuation from Semester I soil practicals)



Suggested Readings:

1. Environmental Pollution and Control — Jeffrey W. Vincoli
2. Environmental Chemistry — A. K. De
3. Air Pollution — M. N. Rao & H. V. N. Rao
4. Introduction to Environmental Engineering and Science — Gilbert M. Masters & Wendell P. Ela
5. Environmental Engineering — Howard S. Peavy, Donald R. Rowe & George Tchobanoglous
6. Environmental Studies — Anubha Kaushik & C. P. Kaushik
7. Wastewater Engineering: Treatment and Resource Recovery — George Tchobanoglous
8. Marine Pollution — R. B. Clark
9. Environmental Engineering — S. K. Garg
10. Solid and Hazardous Waste Management — M. N. Rao & Razia Sultana



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 8****CODE: MJES 803 PAPER NAME: APPLIED CLIMATOLOGY, OCEAN DYNAMICS AND CLIMATE VARIABILITY****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 8 ENVIRONMENT SCIENCE MAJOR 2	NO. OF LECTURES
1	Unit I: Weather Dynamics and Applied Climatology Atmospheric circulation systems and climate regulation, Dynamics of air masses, fronts, cyclones and anticyclones, Monsoon dynamics and seasonal weather systems, Mechanisms of extreme weather events, Thunderstorms, lightning and severe atmospheric phenomena, Climate classification systems and climatic controls, Urban and regional climate modifications, Heat waves, droughts and floods: causes and trends, Climate variability and teleconnections, Applied climatology in agriculture, water resources and disaster management	15
2	Unit II: Physical Oceanography and Ocean-Climate Interactions Ocean circulation dynamics: surface and deep-water circulation, Thermohaline circulation and global conveyor belt, Coastal hydrodynamics: tides, waves and coastal currents, Upwelling and downwelling processes, Air-sea interaction and ocean heat transport, ENSO, Indian Ocean Dipole (IOD) and monsoon coupling, Tropical cyclones over Indian seas, Ocean carbon exchange and marine climate regulation, Sea-level variability and coastal vulnerability assessment, Marine biogeochemical processes and ocean productivity	15
3	Unit III: Climate Change Science, Monitoring and Environmental Applications Climate change indicators and observational evidence, Climate forcing mechanisms and feedback processes, Paleoclimate reconstruction techniques, Stable and radiogenic isotopes in climatology and oceanography, Climate modelling: concepts, scenarios and projections, Climate datasets and environmental data interpretation, GIS and remote sensing applications in climate studies, Climate risk and vulnerability assessment, Impacts of climate change on ecosystems, agriculture and coastal regions, Adaptation, mitigation and resilience strategies, IPCC assessments, UNFCCC and global climate governance	15



**DETAILED SYLLABUS OF B.Sc. 4th YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 8

CODE: MJES 804

**PAPER NAME: APPLIED CLIMATOLOGY, OCEAN DYNAMICS AND CLIMATE
VARIABILITY**

KSKV Kachchh University, Bhuj - Kachchh

PRACTICAL	AIM OF PRACTICAL
1	Assessment of microbial diversity in environmental samples
2	Biotransformation of metals (iron and copper)
3	Bioremediation of metal-contaminated samples
4	Ferrous bio-oxidation and sulphur oxidation studies
5	Biodeterioration studies and microbial degradation processes
6	Microbial applications in environmental remediation (advanced extension beyond Semester I isolation techniques)
7	Assessment of microbial diversity in environmental samples
8	Biotransformation of metals (iron and copper)
9	Bioremediation of metal-contaminated samples
10	Ferrous bio-oxidation and sulphur oxidation studies



Suggested Readings:

1. Atmosphere, Weather and Climate — Roger G. Barry & Richard J. Chorley
2. Physical Climatology — Dennis L. Hartmann
3. Climatology: An Atmospheric Science — J. R. Mather & G. A. Yoshioka
4. Principles of Physical Oceanography — John R. Apel
5. Descriptive Physical Oceanography: An Introduction — Lynne D. Talley, George L. Pickard, William J. Emery & James H. Swift
6. Ocean Circulation and Climate: A 21st Century Perspective — Gerold Siedler, Stephen M. Griffies, John Gould & John A. Church
7. Global Physical Climatology — Dennis L. Hartmann
8. Climate Change: The Physical Science Basis — Intergovernmental Panel on Climate Change (IPCC)
9. Remote Sensing and GIS for Environmental Studies — M. Anji Reddy
10. Introduction to Climate Change and Climate Modeling — Thomas Stocker



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 8****CODE: MJES 805****PAPER NAME: INDUSTRIAL SAFETY, DISASTER MANAGEMENT AND RISK REDUCTION****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 8 ENVIRONMENT SCIENCE MAJOR 3	NO. OF LECTURES
1	Industrial Safety, Occupational Health and Risk Assessment Fundamentals and significance of industrial safety management, Industrial hazards: physical, chemical, biological, mechanical and ergonomic hazards, Hazard identification, risk assessment and control measures, Industrial hygiene and occupational health, Occupational health monitoring and surveillance, Applied ergonomics and workplace safety, Safety regulations and legislation in India, Industrial safety standards and compliance systems, Introduction to industrial risk assessment techniques: HAZOP and HAZID, Environmental Impact Assessment (EIA) and industrial safety linkages, ESG (Environmental, Social and Governance) framework in industries, Safety audits and emergency preparedness in industries (suggested modern addition)	15
2	Disaster Science, Hazards and Environmental Emergencies Concepts and classification of disasters and hazards, Natural disasters: earthquakes, tsunamis, volcanic eruptions, cyclones, floods, droughts, landslides and forest fires, Anthropogenic disasters: industrial, chemical and technological hazards, Climate-induced disasters: heatwaves, sea-level rise and extreme weather events, Coastal vulnerability and disasters associated with coastal development, Urban flooding and environmental emergencies, Disaster mechanisms and processes, Debris management, disposal and recycling after disasters, Disaster risk mapping using GIS and geospatial tools, Case studies of major Indian and global disasters, Sendai Framework for Disaster Risk Reduction (SFDRR), Emerging concepts in multi-hazard risk assessment (suggested addition).	15
3	Disaster Management, Resilience and Policy Frameworks Disaster management cycle: preparedness, mitigation, response, recovery and rehabilitation, Concepts of vulnerability, resilience and disaster risk reduction (DRR), Community-based disaster management and participatory approaches, Disaster management for	15



vulnerable populations and special-needs groups, Disaster psychology and psychosocial support, Role of training and capacity building in disaster management, Strategic planning and emergency response systems, Early warning systems and technology integration in disaster management, Post-disaster recovery and resilience planning, Institutional frameworks and policies: NDMA, SDMA and Disaster Management Act, Climate change adaptation and disaster resilience, Management of spontaneous volunteers during disasters, Case studies: Uttarakhand floods, Odisha cyclones and other Indian disasters Sustainable and resilient urban planning (suggested modern addition)



**DETAILED SYLLABUS OF B.Sc. 4TH YEAR
ENVIRONMENT SCIENCE
(PRACTICAL PAPER)**

SEMESTER - 8

CODE: MJES 806

**PAPER NAME: INDUSTRIAL SAFETY, DISASTER MANAGEMENT AND
RISK REDUCTION**

KSKV Kachchh University, Bhuj - Kachchh

PRACTICAL	AIM OF PRACTICAL
1	Study and identification of marine biodiversity and associated species
2	Waste characterization and segregation studies
3	Basic statistical analysis using Excel/R for environmental datasets
4	Environmental case study preparation on pollution/disaster events
5	Interpretation and presentation of environmental datasets
6	Industrial visit for study of Effluent Treatment Plant (ETP)/Sewage Treatment Plant (STP)
7	Field-based environmental data collection techniques
8	Preparation of scientific field reports and environmental audit summaries



Suggested Readings:

1. Industrial Safety Management — L. M. Deshmukh
2. Safety, Health and Environment — D. P. Khandelwal
3. Industrial Safety and Health Management — C. Ray Asfahl & David W. Rieske
4. Introduction to Safety Engineering — Frank R. Spellman
5. Environmental Impact Assessment — Larry W. Canter
6. Disaster Management — Harsh K. Gupta
7. Disaster Management and Preparedness — N. C. Dhoundiyal
8. Introduction to International Disaster Management — Damon P. Coppola
9. At Risk: Natural Hazards, People's Vulnerability and Disasters — Ben Wisner, Piers Blaikie, Terry Cannon & Ian Davis
10. The Disaster Management Cycle: A Framework for Preparedness and Response — Rajib Shaw & Yukiko Takeuchi



DETAILED SYLLABUS OF B.Sc. 4th YEAR**SEMESTER - 8****CODE: MNES 807****PAPER NAME: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES****KSKV Kachchh University, Bhuj - Kachchh**

UNIT	SEMESTER 8 ENVIRONMENT SCIENCE MINOR 1	NO. OF LECTURES
1	Fundamentals of Pollution and Atmospheric Pollution Processes Definition, concepts and classification of pollution and pollutants, Types, origin, properties and sources of pollutants, Composition and structure of atmosphere, Primary and secondary air pollutants, Major air pollutants: PM _{2.5} , PM ₁₀ , VOCs, black carbon, methane, tropospheric ozone, Behavior, transport, transformation and fate of air pollutants in atmosphere, Photochemical smog and atmospheric reactions, Greenhouse gases, global warming and climate pollutants, Chlorofluorocarbons (CFCs) and ozone layer depletion, Carbon footprint and emission inventories, Indoor air pollution and associated health impacts, Air Quality Index (AQI): concept, calculation and interpretation, Atmospheric stability, lapse rates, wind systems, turbulence and plume behaviour, Dispersion of pollutants and Gaussian plume model (basic concept), Air pollution monitoring techniques and sampling methods, Continuous Ambient Air Quality Monitoring Systems (CAAQMS), Remote sensing applications in air pollution monitoring, Source apportionment studies, Air pollution control methods and equipment, Ambient air quality standards.	15
2	Unit II: Water, Marine and Thermal Pollution Introduction, definition, sources and types of water pollutants, Surface water and groundwater pollution, Physical, chemical and biological effects of water pollution, Wastewater treatment processes: preliminary, primary, secondary and tertiary treatment, Removal of suspended and dissolved solids, nitrogen and phosphorus, Advanced biological treatment systems and chemical oxidation processes, Resource recovery from process effluents and Water purification methods, Wastewater reuse and recycling technologies, Nature-based wastewater treatment systems (constructed wetlands), Marine pollution: sources and nature of pollutants, Oil spills and oil pollution, Heavy metals and metallic pollutants in marine systems, Coastal and estuarine pollution in India, Marine plastic pollution and	15



	microplastics, Emerging contaminants: pharmaceuticals and PFAS, Sea level rise: causes, impacts and control measures, Chemicals and drugs from oceans, Thermal pollution: concept, sources and impacts, Thermal power plant pollution, Effects of thermal pollution on water quality and marine life, Prevention and control of thermal pollution	
3	Unit III: Soil, Noise, Radiation and Solid Waste Pollution Management Soil Pollution: Sources, types and processes of soil pollution, Soil degradation and contamination, Soil pollution management and remediation, Integrated Pest Management (IPM) and Integrated Nutrient Management (INM), Land restoration approaches Noise Pollution: Characteristics and sources of noise pollution, Measurement and standards of noise as well as noise indices and numerics, Impacts of noise pollution on humans and environment, Noise control and mitigation measures Radiation Pollution: Sources and types of radiation pollution, Biological effects of radiation, Radiation safety and control measures Solid and Hazardous Waste Management: Municipal, industrial, biomedical and hazardous wastes, Waste handling, segregation and disposal methods, Waste treatment technologies: incineration, pyrolysis and composting, Resource recovery and circular economy approaches	15



DETAILED SYLLABUS OF B.Sc. 4th YEAR

ENVIRONMENT SCIENCE

(PRACTICAL PAPER)

SEMESTER - 8

CODE: MNES 808

PAPER NAME: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES

KSKV Kachchh University, Bhuj - Kachchh

PRACTICAL	AIM OF PRACTICAL
1	Determination of physical characteristics of water: colour, turbidity, TDS, TSS, dissolved solids, acidity and alkalinity
2	Determination of Dissolved Oxygen (DO)
3	Determination of Biological Oxygen Demand (BOD)
4	Determination of Chemical Oxygen Demand (COD)
5	Estimation of chloride in water and soil samples
6	Determination of total calcium and magnesium
7	Determination of total nitrogen, phosphorus and organic carbon from environmental samples
8	Drinking water analysis using Membrane Filter Technique (MFT) for coliform detection
9	Soil salinity and nutrient assessment (advanced continuation from Semester I soil practicals)



Suggested Readings:

1. Environmental Pollution and Control — Jeffrey W. Vincoli
2. Environmental Chemistry — A. K. De
3. Air Pollution — M. N. Rao & H. V. N. Rao
4. Introduction to Environmental Engineering and Science — Gilbert M. Masters & Wendell P. Ela
5. Environmental Engineering — Howard S. Peavy, Donald R. Rowe & George Tchobanoglous
6. Environmental Studies — Anubha Kaushik & C. P. Kaushik
7. Wastewater Engineering: Treatment and Resource Recovery — George Tchobanoglous
8. Marine Pollution — R. B. Clark
9. Environmental Engineering — S. K. Garg
10. Solid and Hazardous Waste Management — M. N. Rao & Razia Sultana



Dissertation / Project work/ On Job Training Report Environmental Issue/Survey Project Report – (Based on Major Paper of 06 Credits, 75 Marks internal Exam + 75 Marks External Exam = Total 150 Marks.)

The purpose of this exercise is to become familiar with research methods, computer application, literacy and the presentation skills. Moreover, to think about how to approach, communicate and assess an environmental issue from various viewpoints (economic, environmental, legislative, societal, etc.). All viewpoints must be addressed in your outline and project. The student has the freedom to select any research problem related to the environmental science; they can also work for their Bechlore's thesis in the department or research institutes or industry with prior communication and approval from both the side.

1. Select an Environmental issue / Research Problem consult faculty for guidance.
2. Learn what resources are available and how to access them
3. Collect references, secondary information on the topic and prepare bibliography
4. Set the methodology, approve it from faculty/supervisor and run the experiments
5. Collect findings and draw your conclusion and prepare a detailed report/thesis
6. Record Results (statistics w/data tables) and Interpret and explain results (using charts)
7. Use outline and related research to develop a PowerPoint presentation of your topic
8. Present topic and survey to class (summarize the research and results) and explain what your results mean.

The outline must include the following:

- Literature Review section should include citations and or references from previous studies of the topic
- References must be taken from a book, magazine, newspaper and Internet (At least one from each).
- Make certain that your cited sources are in APA Citation Style.

Evaluation Method:

A 10 to 20 minute formal oral presentation during the Internal/ final examination must include the following:

- A PC PowerPoint Slide Presentation showing your objectives, methodology, findings, conclusion and message to convey.
- Followed by Viva voce from Internal/ External Examiners.



KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY

Theory assessment (Other than Dissertation/ OJT)

Pattern for Semester end Examination

Question	Question Type	Total Marks	Remarks
1 (From Unit – 1)	Descriptive Questions with Internal Option.	10 Marks	Question may be of 10 marks/ 5 + 5 marks
2 (From Unit – 2)	Descriptive Questions with Internal Option.	10 Marks	Question may be of 10 marks/ 5 + 5 marks
3 (From Unit – 3)	Descriptive Questions with Internal Option.	10 Marks	Question may be of 10 marks/ 5 + 5 marks
4 (From Unit – 1, 2, 3)	Short Questions, fill in the Blanks, MCQ, etc. 7 questions (from all three units) will be asked with option (05 out of 07)	05 Marks	Total 07 questions from all units will be asked; students have to attempt any 05

Note:

1. The descriptive questions i.e. Question 1, 2, 3 will be like *Explain, describe, discuss* etc. type which may be of 10 marks or 05 + 05 marks.
2. Examiner can ask two questions of 10 marks, of which one must be attempt or examiner can ask three questions of 05 marks, of which two must be attempt.
3. The fourth question can ask from all three units. Total 07 questions will be asked, of which 05 must be attempt. Each question carries 01 mark.

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For Internal / College theory assessment (Other then Dissertation/ OJT)

Continuous evolution method will be applied for college assessment. Internal theory examination/ Unit test, Seminar, Assignments, Group discussions etc. will be the key part for the internal/ college assessment. The internal assessment will be of 35 marks.

The passing criteria for Internal/ college assessment is 40% i.e. students have to secure 14 marks out of 35 marks.

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Practical assessment (Other then Dissertation/ OJT)

Pattern for Semester end Examination

For university assessment of practicals, 4 to 5 exercises will be arranged for students according to the prescribed syllabus.

The University Practical assessment is of 15 marks.

The passing criteria for practical assessment is 40% i.e. students have to secure 06 marks out of 15 marks.

For Internal / College assessment

For Internal/ college assessment of practical, 4 to 5 exercises will be arranged for students according to the prescribed syllabus.

The Internal/ college Practical assessment is of 15 marks.

The passing criteria for practical assessment is 40% i.e. students have to secure 06 marks out of 15 marks.



(Mrugesh Trivedi)



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