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Office of the
Deputy Director (Curriculum)
Academics Division

No. HEC/CD/NCRC/ENV-SCI/2025/**7511**
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SUBJECT: REVISED CURRICULA FOR ENVIRONMENTAL SCIENCE

The Higher Education Commission (HEC) of Pakistan, as mandated by its law, provides guidance to Higher Education Institutions (HEIs) on curricula for tertiary education levels in alignment with the National Qualifications Framework (NQF). To address evolving academic trends and market demands, HEC in collaboration with the Pakistan Academy of Sciences (PAS) has revised the curricular standards for Environmental Science degree programs at NQF levels 5, 6 and 7. These updated standards are intricately aligned with HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023) ensuring coherence with national priorities and adherence to international benchmarks.

2. The revised curricula for Environmental Science degree programs are hereby notified. Universities offering these programs are advised to align their Environmental Science curricula with these updated standards as a minimum requirement. The respective departments must also develop course contents in accordance with the prescribed framework, ensuring that the programs address evolving scholarly, and professional needs to enhance employability potential of Environmental Science graduates. Subsequently, the finalized course contents should be submitted electronically to this office at the earliest. An electronic copy of the revised curricula is available on HEC's official website.

3. With the support of universities in implementing these standards, HEC envisions a future where Environmental Science graduates contribute meaningfully to scientific advancement, sustainable development, and societal well-being through evidence-based knowledge and interdisciplinary engagement.

MUHAMMAD ALI BAIG

Vice Chancellors/Rectors/Heads
All Public/Private Sector Universities/DAIs

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CURRICULUM FOR

ENVIRONMENTAL SCIENCE DEGREE PROGRAMS

Associate Degree | Bachelor of Science | Master of Science

2025

A Collaborative Venture of
HIGHER EDUCATION COMMISSION & PAKISTAN ACADEMY OF SCIENCES
Government of Pakistan

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PREFACE

The curriculum serves as a comprehensive blueprint for the teaching-learning process that students must navigate to achieve specific academic objectives. This encompasses clearly defined prior learning requirements, program objectives, scheme of studies, and course learning outcomes. As knowledge rapidly evolves and new fields emerge, it is crucial to continually develop and revise curricula to ensure they remain current, relevant, and impactful.

As mandated by its law through Clause 10-1 (a), (l), (s), and (v), the Higher Education Commission (HEC) of Pakistan has been developing and periodically updating curricula through its National Curriculum Revision Committees (NCRCs). These committees are generally composed of subject matter experts, researchers, and representatives from accreditation bodies, professional councils, and industry stakeholders. In response to the evolving needs, HEC in collaboration with the Pakistan Academy of Sciences (PAS) has undertaken the task to develop robust standards for the curricula of degree programs in Environmental Science at levels 5, 6 and 7 of the National Qualifications Framework. These standards are meticulously structured in accordance with the HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring alignment with both national priorities and international educational standards.

The degree programs in Environmental Science are designed to provide students with interdisciplinary knowledge and practical competencies in key areas such as climate science, environmental policy, ecosystem management, pollution control, and sustainability. These programs integrate scientific theory with applied research and field-based learning, equipping graduates to address complex environmental challenges at local, regional, and global scales. The curricular standards, developed by subject experts from across the country, are intended to strengthen the academic rigor and societal relevance of Environmental Science education by promoting critical thinking, evidence-based analysis, and environmentally responsible practice. Graduates are prepared for diverse career trajectories in environmental research, policy development, conservation, climate change mitigation, and sustainable development sectors.

With the support of universities in implementing these standards, HEC envisions a future where Environmental Science graduates contribute meaningfully to scientific advancement, sustainable development, and societal well-being through evidence-based knowledge and interdisciplinary engagement.

Dr. Amjad Hussain
Director General
Academics Division

GUIDING PRINCIPLES

Minimum Standards

The curricular standards and guidelines prescribed in this document are mandatory at minimum level. Universities or the departments concerned may, however, set higher standards provided that the standards prescribed herein are not reduced or compromised.

Course Sequence, Titles & Credits

For Associate Degree (AD), Bachelor of Science (BS) and Master of Science (MS) in Environmental Science, the sequence of courses prescribed in this document is logically arranged and is suggestive only. The department concerned may rearrange the sequence and alter the course titles and credit hours provided that the essence of the courses prescribed herein remains intact. The department concerned may also add more courses as and when required subject to the approval of the university's relevant statutory body.

Course Learning Outcomes

Course learning outcomes (CLOs) are the bare minimum standards of learning that students must achieve upon completing a specific course. While these standards must not be compromised, departments are encouraged to enhance the rigor of the CLOs by incorporating additional learning outcomes, provided these do not alter the essence of the prescribed standards. In this document, CLOs are developed for major and interdisciplinary courses and whereas for electives, the concerned departments are required to develop their CLOs considering the course's advanced nature. For General Education courses as prescribed in the HEC Undergraduate Education Policy V 1.1 including the courses of "Pakistan Studies" and "Understanding of Holy Quran I & II", the departments may adopt the CLOs as prescribed in the HEC developed model courses.

Course Syllabus

This document serves as a comprehensive guideline delineating the CLOs for each course as prescribed for the AD, BS and MS Environmental Science as minimum standards. The department concerned is required to prepare, modify, and tailor the syllabus of each course, ensuring alignment with the stipulated learning outcomes and scholarly demands. It is in this regard imperative that the department concerned utilizes instructional, reference, and reading materials that it deems appropriate to effectively meet the CLOs.

General Education

For AD and BS Environmental Science, the courses for General Education component including the courses of "Pakistan Studies" and "Understanding of Holy Quran I & II" must mandatorily be offered with the same titles and credit hours as prescribed in the HEC Undergraduate Education Policy V 1.1., and subsequent notifications. The department concerned may adopt and follow the learning outcomes and study contents developed by HEC for these courses as available on its website. The requirement of General Education is not applicable to MS Environmental Science.

Requirement of Internship

Supervised internship of 3 credit hours in accordance with HEC Undergraduate Education Policy V.1.1. is a mandatory degree award requirement for BS. This requirement must be graded and supervised under a faculty member in collaboration with a supervisor in the field, protocols of which will be determined by the concerned department subject to approval of the same by the university's relevant statutory body.

Requirement of Capstone

Capstone is a mandatory degree award requirement of 3 credit hours for BS Environmental Science. It is a multifaceted body of work that serves as a culminating academic and intellectual experience for students. It must be supervised and graded by a faculty member as per the protocols prescribed by the department concerned. This requirement cannot be substituted with additional course work or internship.

Associate Degree

The eligibility criteria and the courses of first-four semesters of the BS Environmental Science as prescribed in this document guide the admission requirement and the structure of AD Environmental Science, respectively. Field experience / internship is not a mandatory requirement for the AD Environmental Science.

Electives

a) In accordance with the National Qualifications Framework, the department is required to offer at least 7 electives comprised of 21 credit hours i.e., minimum of 25% of the major i.e., Environmental Science comprised of 79 credit hours, to meet the criteria of nomenclature with specialization. Where the department increases the range of major beyond 79, the number of electives will accordingly be adjusted.

b) Where the electives are opted from the general pool, the degree will be awarded as BS Environmental Science in its generic form and without any specialization. Example: **Bachelor of Science in Environmental Science**.

c) Where the electives are opted from within a single specialization domain, the degree will be offered as Bachelor of Science in Environmental Science (with name of specialization) in accordance with the National Qualifications Framework (2015). Example: **Bachelor of Science in Environmental Science (Climate Change)**.

d) Subject to approval of the relevant statutory body, the department may develop additional specializations other than those prescribed in this document. It should however be noted that offering of the degree program with specialization is prescribed in this document as an option only and **not** as a mandatory requirement or a binding on the offering department. In view of this, the department concerned may consider offering the degree program with specialization or not, in accordance with its available academic, human and infrastructural resources.

Equivalence of Qualifications

a) All the graduates having degrees of BS Environmental Science with or without specialization will be considered at par in terms of their knowledge, skills and abilities acquired through the course of the degree program, for the purpose of employment and further education. Therefore, all graduates having BS Environmental Science with any specialization are considered equivalent to BS Environmental Science. However, where specific specialization is required by employment agencies such as Environmental Science (Biodiversity Conservation), the same cannot be considered at par with any other specialization such as Environmental Science (Environmental Governance). The titles given above are only examples for clarification.

b) Graduates having NQF level 6 qualifications in any discipline related to the Environmental Science seeking equivalence with BS Environmental Science will be required to have completed at least 60 credit hours of Environmental Science by meeting the following conditions:

I) Completion of courses of at least 54 credits within the field of Environmental Science including:
   - 3 fundamental courses (9 credits) of Environmental Science.
   - 4 interdisciplinary courses (12 credits) of Environmental Science.
   - 7 electives (21 credits) of Environmental Science.
   - A minor (minimum 12 credits) of Environmental Science.

II) Completion of a 3-credit internship in the field of Environmental Science.

III) Completion of a 3-credit capstone in the field of Environmental Science.

c) Upon meeting the above requirements, the graduates having NQF level 6 qualifications in any discipline related to the Environmental Science will be granted equivalence to the BS Environmental Science for employment and further education purposes.

Lab Requirements

Departments offering degree programs in Environmental Science are required to adhere to the discipline / course relevant state-of-the-art lab requirements as minimum standards. Departments are expected to enhance the lab standards as and when required and maintain / upgrade the same to ensure quality education in Environmental Science.

Entry & Exit Provisions at Undergraduate Level

Pathway for Graduates with Associate Degree

a) Candidates who have completed AD Environmental Science are allowed admission in the fifth semester of the BS Environmental Science with or without any deficiency course up to a maximum of 18 credit hours as determined by the concerned university / department. In case the deficiency courses are of more than 18 credit hours, the university concerned may decide not to offer admission in accordance with its screening, admission and merit calculation criteria approved by its statutory bodies.

b) Candidates who have completed AD in any discipline other than but related to the field of Environmental Science shall be required to complete deficiency courses up to a maximum 18 credit hours in a bridging semester as determined by the concerned university / department on case-to-case basis. Relevance of prior qualification in this regard may also be determined by the concerned university / department. In case the deficiency courses are or more than 18 credit hours, the university concerned may decide not to offer admission in accordance with its screening, admission and merit calculation criteria approved by its statutory bodies.

c) The minimum eligibility for admission in the fifth semester in the above cases is 2.00 / 4.00 CGPA in the prior qualification i.e., AD. The university concerned may, however, set higher eligibility and admission criteria for admission in the fifth semester of BS Environmental Science.

Pathway for Graduates with Conventional BSc / Equivalent Degree Programs

a) Candidates having completed two-year conventional BSc / equivalent degree programs are allowed admission in the fifth semester of BS Environmental Science in which case, such students shall be required to complete deficiency courses up to a maximum of 21 credit hours through a bridging semester as determined by the concerned university. In case the deficiency courses are of more than 21 credit hours, the university concerned may decide not offer admission, in accordance with its screening, admission and merit calculation criteria approved by its statutory bodies.

b) The minimum eligibility for admission in the fifth semester in this case is 45% cumulative score in the prior qualification i.e., two-year conventional BSc / equivalent degree programs. The university concerned may, however, set higher eligibility and admission criteria for admission in the fifth semester of BS Environmental Science.

Exiting from Bachelor of Science in Environmental Science with the Associate Degree

Students enrolled in BS Environmental Science are allowed to exit the program provided they have completed the requirements of the first-four semesters of the BS degree program as prescribed in this document, and subject to approval of the university's relevant statutory body.

BACHELOR OF SCIENCE (BS)

Program Description

The program of BS Environmental Science is structured in accordance with the HEC Undergraduate Education Policy V 1.1 (2023) and subsequent notifications, to provide comprehensive understanding of the complex interactions between human societies and the natural environment. Throughout the program, students will be able to study and understand the diverse inter-disciplinary themes to develop a holistic perspective on environmental issues. The program will equip students with the knowledge and skills to address pressing environmental challenges such as climate change, pollution, biodiversity loss, resource depletion etc. By exploring fundamental, contemporary and advanced courses, students will learn to analyze environmental problems, develop sustainable solutions, and make informed decisions to promote environmental conservation and stewardship. As a policy requirement, the program also provides students with an opportunity to engage in a capstone where they apply their interdisciplinary knowledge and research skills to tackle real-world environmental problems or conduct original research. This capstone will allow students to integrate concepts from multiple courses, demonstrate critical thinking and problem-solving abilities, and contribute to the advancement of environmental science. The main goal of this program is to prepare students for diverse career paths in environmental research, consulting, advocacy, policy making, and education having deep understanding of environmental issues, strong analytical and research skills, and a commitment to creating positive environmental change in their communities and beyond.

Standard Nomenclature

The scheme of study prescribed for the four-year undergraduate degree in Environmental Science is based on a total of 7 electives. Where these courses are opted from the general pool of electives, the degree will be titled **Bachelor of Science in Environmental Science** in its generic form and without any specialization. Whereas, if all the electives are opted from within a single specialization domain, the degree will be titled Bachelor of Science in Environmental Science with the name of specialization in parenthesis in accordance with the National Qualifications Framework (2015).

Program Learning Outcomes

By the completion of Bachelor of Science in Environmental Science, the graduates will be able to:

a) Understand and explain the concepts, theories and empirical aspects within the discipline of environmental sciences.
b) Apply interdisciplinary knowledge to analyze and address environmental issues effectively.
c) Demonstrate adequate ability to utilize tools and techniques as applied in the field of environmental sciences.
d) Understand the impact of human activities on environment and natural resources.
e) Develop sustainable solutions to promote environmental conservation and stewardship

Eligibility & Admission Criteria

Higher Secondary School Certificate (involving 12 years of schooling) or an IBCC equivalent qualification in any science group with any of the subjects i.e., Biology, General Biology, Chemistry or Physics is the basic eligibility requirement for admission in the BS Environmental Science including any of its specializations. Further, the university concerned may set minimum eligibility scores and may conduct entry / admission test through its own testing body or an external testing services provider of repute as per the screening, admission and merit calculation criteria approved by its statutory bodies.

Program Structure

The Bachelor of Science in Environmental Science is structured in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1. and comprises of minimum **135** credit hours spread over 8 regular semesters. Universities may offer courses up to a maximum of 148 credit hours provided that the total number of credit hours are reasonably set to achieve the Program Learning Objectives (PLOs) without putting an undue burden on students.

Minimum Credit Hours (including all program related requirements)		135
General Education		34 credit hours (15 courses)
Major	**a) Compulsory**	58 credit hours (20 courses) Mandatory courses as reflected in the scheme of study, irrespective of the area of specialization (where applicable).
	b) Mandatory Electives	21 credit hours (7 courses) (to be opted from either general pool of electives or from a particular specialization)
	Total Major Requirement	79 credit hours (27 courses)
Interdisciplinary Courses		16 credit hours (6 courses)
Internship		3 credit hours
Capstone Project		3 credit hours
Program Duration		Minimum: 4 Years Maximum: 6 Years (further extendable to another year subject to approval of university's statutory body)
Semester Duration		16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)		15-18 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial / deficiency / failure / repeat courses only)
3 Credit Hours (Theory)		3 classes (1 hour each) **OR** 2 classes (1.5 hour each) **OR** 1 class (3 hours) per week throughout the semester
1 Credit Hour (Lab/equivalent)		Practical / lab / studio / field work of 1 credit hour requires 3 hours per week throughout the semester

The standard scheme of studies for the program of BS Environmental Science (irrespective of the area of specialization) is given as under:

SEMESTER I			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Introduction to Environmental Science	3 (3-0)	Major
2	Principles of Biology	3 (2-1)	Interdisciplinary
3	Quantitative Reasoning – I *	3 (3-0)	General Education
4	Natural Science **	3 (2-1)	General Education

5	Islamic Studies * (Religious Edu / Ethics for non-Muslim students)	2 (2-0)	General Education
6	Applications of Information & Communication Technologies *	3 (2-1)	General Education
7	Understanding of Holy Quran – I *	1 (0-1)	General Education
Total Credits Hours = 18			

SEMESTER II			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Fundamentals of Ecology	3 (3-0)	Major
2	Basic Chemistry	3 (3-0)	Interdisciplinary
3	Quantitative Reasoning – II *	3 (3-0)	General Education
4	Social Sciences ***	2 (2-0)	General Education
5	Functional English *	3 (3-0)	General Education
6	Pakistan Studies *	2 (2-0)	General Education
7	Arts & Humanities ****	2 (2-0)	General Education
Total Credits Hours = 18			

SEMESTER III			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Environmental Chemistry	3 (2-1)	Major
2	Environmental Physics	3 (2-1)	Major
3	Mineral Resources	3 (3-0)	Major
4	Introduction to Earth Sciences	2 (2-0)	Interdisciplinary
5	Expository Writing *	3 (3-0)	General Education
6	Civics & Community Engagement *	2 (2-0)	General Education
7	Ideology & Constitution of Pakistan *	2 (2-0)	General Education
Total Credit Hours = 18			

SEMESTER IV			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Environmental Toxicology	3 (2-1)	Major
2	Environmental Pollution	3 (3-0)	Major
3	Applied Ecology	3 (2-1)	Major
4	Environmental Microbiology	3 (3-0)	Major
5	Water & Wastewater Treatment	3 (3-0)	Major
6	Understanding of Holy Quran – II *	1 (0-1)	General Education
7	Entrepreneurship *	2 (2-0)	General Education
Total Credit Hours = 18			

SEMESTER V			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Analytical Techniques in Environmental Science	3 (2-1)	Major
2	Research Methods in Environmental Science	3 (3-0)	Major
3	Geographical Information Systems & Remote Sensing	3 (2-1)	Major
4	Environmental Governance	2 (2-0)	Major
5	Climate Change	2 (2-0)	Major
6	Environmental Economics	2 (2-0)	Interdisciplinary
Total Credit Hours = 15			

SEMESTER VI			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Disaster Risk Management	3 (3-0)	Major
2	Solid Waste Management	3 (3-0)	Major
3	Environmental Management Systems	3 (2-1)	Major
4	Elective – I *****	3	Major
5	Elective – II *****	3	Major
Total Credit Hours = 15			

SEMESTER VII			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Biodiversity & Conservation	3 (3-0)	Major
2	AI & Emerging Technologies in Environmental Science	3 (2-1)	Major
3	Elective – III *****	3	Major
4	Elective – IV *****	3	Major
5	Sustainable Development	3	Interdisciplinary
Total Credit Hours = 15			

SEMESTER VIII			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Elective – V ******	3	Major
2	Elective – VI ******	3	Major
3	Elective – VII ******	3	Major
4	Health, Safety & Environmental Management	3 (3-0)	Interdisciplinary
5	Capstone Project	3	Capstone
Total Credit Hours = 15			

* HEC designed **model courses** for general education may be used by the university.

** The university / concerned department may offer any course in the broader category of **"Natural Sciences"** which should have relevance to the purpose of the degree program.

*** The university / concerned department may offer any course in the broader category of **"Social Sciences"** including but not limited to a course of Sociology, Social Work, Anthropology, Psychology, Education etc.

**** The university / concerned department may offer any course in the broader category of **"Arts & Humanities"** including but not limited to a course of regional or international language such as Chinese, Arabic, French, Spanish etc. or any other course such as Philosophy, History etc.

***** Read in conjunction with guidance given on "**Standard Nomenclature**" in this document, the university / concerned department may offer any 7 advanced courses from either the general pool or from within one of the specializations as **electives** keeping in view its available academic, human and infrastructural resources. **Credit combination** may be arranged in accordance with the nature of the course.

Degree Award Requirements

The following minimum requirements are prescribed for the award of BS Environmental Science:

a) All courses in the General Education category with titles and credit hours as prescribed in HEC Undergraduate Education Policy V 1.1. including the courses of "Pakistan Studies", "Understanding of Holy Quran – I" and "Understanding of Holy Quran – II" must be completed.

b) A minimum of **135** credit hours as prescribed in this document must be completed.
c) A capstone of 3 credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework or internship / field experience.
d) A supervised internship of 3 credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone or project work.
e) CGPA must not be below 2.00/4.00 at the time of completion of the degree program. The university may, however, set a higher standard in this regard.
f) The minimum duration to complete the degree is 8 regular semesters spread over 4 years whereas the maximum duration is 12 regular semesters spread over 6 years. The maximum duration may further be extended to 2 more semesters **(OR)** 1 year, in extraordinary circumstances subject to approval of the university's relevant statutory body. Summer semester is not considered as a regular semester.

MAJOR SPECIALIZATIONS FOR BS

Major Specializations for BS Environmental Science

The following are a few example specialization streams in case the BS Environmental Science is offered with specialization. Subject to approval of the relevant statutory body, the department may develop additional specializations other than those prescribed below. The department concerned may consider offering the degree program with specialization or otherwise, keeping in view availability of its academic, human and infrastructural resources.

Specialization 1: Biodiversity Conservation

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Community-based Conservation
b) Conservation Genetics
c) Conservation Policy
d) Ecosystem Services Valuation
e) Endangered Species Recovery
f) Forest Ecosystem Dynamics
g) Habitat Connectivity Planning
h) Invasive Species Ecology
i) Landscape Ecology
j) Plant Diversity Conservation
k) Restoration Ecology
l) Tropical Ecology
m) Wetland Ecology
n) Wildlife Forensics
o) Wildlife Habitat Management

Specialization 2: Climate Change

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Carbon Sequestration Techniques
b) Climate Adaptation Planning
c) Climate Finance Mechanisms
d) Climate Modeling
e) Climate Policy & Diplomacy
f) Climate Risk Assessment
g) Energy System Transitions
h) Environmental Statistics
i) Greenhouse Gas Emissions Monitoring
j) Low Carbon Technologies
k) Mitigation Strategies Design
l) Ocean-Atmosphere Interactions
m) Regional Climate Impacts

n) Renewable Energy Transitions
o) Resilience Building Strategies

Specialization 3: Environmental Governance

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Corporate Environmental Responsibility
b) Environmental Compliance Mechanisms
c) Environmental Justice
d) Environmental Monitoring Protocols
e) Environmental Policy Analysis
f) Ethics in Environmental Decision-Making
g) Governance of Common Resources
h) Institutional Frameworks for Environment
i) International Environmental Agreements
j) Natural Resource Law
k) Policy Impact Evaluation
l) Public Participation in Governance
m) Strategic Environmental Planning
n) Sustainable Development Law
o) Transboundary Environmental Issues

Specialization 4: Environmental Toxicology

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Bioaccumulation Processes
b) Biomarkers of Exposure
c) Ecotoxicology
d) Environmental Mutagenesis
e) Environmental Pathology
f) Genetic Toxicology
g) Human Health Risk Assessment
h) Industrial Waste Toxicology
i) Molecular Toxicology
j) Nanotoxicology
k) Occupational Toxicology
l) Pesticide Chemistry
m) Toxic Substances in Food Chains
n) Toxicokinetics
o) Waterborne Toxicants

Specialization 5: Waste Management

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Biomedical Waste Handling
b) Circular Economy Models
c) Composting Systems
d) E-Waste Management
e) Hazardous Waste Management
f) Industrial Waste Recycling
g) Landfill Design & Operation
h) Plastic Waste Solutions
i) Policy for Waste Regulation
j) Resource Recovery Techniques
k) Urban Waste Systems
l) Waste Audit Techniques
m) Waste Collection Logistics
n) Waste-to-Energy Technologies
o) Zero Waste Systems

Specialization 6: Water Resource Management

Below is the recommended list of courses within the given specialization. The department concerned may offer courses from the following list or any other course as elective(s) relevant to the given specialization, keeping in view its available academic, human and infrastructural resources:

a) Agricultural Water Use
b) Drinking Water Standards
c) Floodplain Management
d) Groundwater Resource Management
e) Hydraulics & Water Engineering
f) Hydrological Modeling
g) Integrated Watershed Management
h) Irrigation System Design
i) River Basin Planning
j) Transboundary Water Issues
k) Urban Water Systems
l) Water Policy & Regulation
m) Water Quality Monitoring
n) Water Security Challenges
o) Wetlands Management

MASTER OF SCIENCE (MS)

Program Description

The Master of Science (MS) in Environmental Science program is designed in accordance with the HEC Graduate Education Policy 2023 to provide students with advanced, interdisciplinary knowledge across key domains of Environmental Science. The program will equip students with a deep understanding of the scientific, technological, and policy dimensions of environmental challenges at local, regional, and global levels. Students will be engaged in rigorous coursework and research to develop expertise in environmental systems analysis, environmental impact assessment, and the application of innovative solutions for sustainable development. Emphasis is placed on integrating theoretical knowledge with practical skills through laboratory techniques, data analytics, and policy evaluation. Graduates of this program will be prepared for leadership roles in academia, industry, government, and non-governmental organizations, contributing to the advancement of environmental sustainability and resilience.

Standard Nomenclature

To ensure uniformity, the standard nomenclature for all NQF level 7 qualifications in the field of Environmental Science must be **"Master of Science in Environmental Science"**.

Program Learning Outcomes

By the completion of MS Environmental Science, the graduates will be able to:

a) Demonstrate advanced proficiency in applying strategic environmental assessment principles and methodologies to evaluate the environmental impacts of policies, plans, and projects.
b) Utilize advanced research methods to investigate complex environmental phenomena, generate new knowledge, and inform evidence-based decision-making in environmental science.
c) Communicate effectively with diverse stakeholders, including policymakers, scientists, and community members, to facilitate informed dialogue and collaborative efforts towards addressing environmental issues.
d) Contribute to the advancement of knowledge in the field of environmental science through scholarly research and publications that address critical environmental challenges and promote sustainable development.

Eligibility & Admission Criteria

a) An undergraduate degree (involving 16 years of education) in Environmental Science or any of its fields / specializations is the basic eligibility requirement for admission to the Master of Science in Environmental Science. In case the candidate has knowledge deficiency, the university concerned may offer deficiency courses up to a maximum of 9 credit hours as it may determine on case-to-case basis and in accordance with HEC Graduate Education Policy (2023).
b) In addition to the basic eligibility, the university concerned is further required to conduct a rigorous admission test as an eligibility condition for admission to the program, with a passing score of 50% **(OR)** accept the GRE / HAT General / equivalent tests, with a passing score of 50%. The university concerned may also set minimum eligibility scores (above 50%) as per the screening, admission and merit calculation criteria approved by its statutory bodies.

Program Structure

The standard structure of the degree program is as below:

Minimum Credit Hours		32
Course Work	**a) Mandatory Subject Core**	12 credit hours (4 courses)
	b) Subject Electives	12 credit hours (4 courses)
	c) Mandatory Quranic Courses	2 credit hours (2 courses)
	Total Coursework Requirement	26 credit hours
Research Thesis		6 credit hours
Program Duration		Minimum: 1.5 Years (3 regular semesters) Maximum: 4 Years (8 regular semesters) **Note:** In case a student is unable to secure an MS within the prescribed timeframe and claims for extension in duration, the university may constitute appropriate authority and determine the causes of delay. In the event of force majeure (i.e., delay on account of circumstance beyond the control of student), the university may grant an extension in the period of award of MS degree in accordance with the duration limiting factor(s) and shall also take corrective measures in case the delay is caused by process or administrative reasons.
Semester Duration		16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)		09-12 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial / deficiency / failure / repetition courses only)
3 Credit Hours (Theory)		3 classes (1 hour each) **OR** 2 classes (1.5 hour each) **OR** 1 class (3 hours) per week throughout the semester
1 Credit Hour (Lab/equivalent)		Practical / lab / field work of 1 credit hour requires 3 hours per week throughout the semester

The standard scheme of studies for MS Environmental Science is given below:

SEMESTER I			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Strategic Environmental Assessment *	3 (3-0)	Core
2	Advanced Research Methods in Environmental Science *	3 (3-0)	Core
3	Elective – I **	3	Elective
4	Elective – II **	3	Elective
Total Credit Hours = 12			

SEMESTER II			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Climate Change Adaptation & Mitigation *	3 (3-0)	Core
2	Advanced Analytical Techniques in Environmental Science *	3	Elective
3	Elective – III **	3	Elective
4	Elective – IV **	3	Elective
Total Credit Hours = 12			

SEMESTER III			
S.N.	**COURSE**	**CREDIT HOURS**	**CATEGORY**
1	Understanding of Holy Quran – I ***	1 (0-1)	General Education
2	Understanding of Holy Quran – II ***	1 (0-1)	General Education
3	Thesis ****	6	Research
Total Credit Hours = 8			

* These are the **mandatory** courses for the program, irrespective of the area of specialization.

** The university / concerned department may offer any advanced course in the field of Environmental Science as an **elective**, where required as per its available academic, human and infrastructural resources. **Credit combination** (reflecting balance of theory and lab / field work) must be arranged in accordance with the nature of the course.

*** These are prescribed for all NQF level 4-8 qualifications as mandated vide HEC letter **No. 10-01/2022/Coord(Acad)/HEC/235** dated March 28, 2025.

**** **Research** work for thesis must be conducted by students individually in accordance with the university's policy as approved through its statutory bodies provided that the same is in accordance with the HEC Graduate Education Policy (2023).

Degree Award Requirements

The following minimum requirements are prescribed for award of MS Environmental Science:

a) A minimum of 26 credit hours of course work including 12 credit hours for core courses, 12 credit hours for electives and 2 credit hours for Quranic courses as prescribed in this document must be completed.

b) In addition to coursework, a research thesis of 6 credit hours must also be completed individually as partial fulfilment of the degree program. Requirement of research thesis cannot be substituted with additional course work.

c) CGPA must not be below 2.50 / 4.00 at the time of completion of the degree program. The university may, however, set a higher standard in this regard.

d) The minimum duration required to complete the degree is 3 regular semesters which may be extended up to a maximum of 8 regular semesters. Summer semester is not considered as a regular semester.

COURSE LEARNING OUTCOMES

AD, BS & MS
(Arranged in Alphabetical Order)

Advanced Analytical Techniques in Environmental Science

By the end of this course, students will be able to:

a) Understand advanced principles and specialized applications of analytical techniques used in complex environmental assessments.
b) Apply high-resolution methods such as inductively coupled plasma mass spectrometry (ICP-MS), gas chromatography-mass spectrometry (GC-MS), and high-performance liquid chromatography (HPLC) for environmental sample analysis.
c) Critically evaluate analytical data for precision, accuracy, and relevance in addressing advanced environmental research problems.

Advanced Research Methods in Environmental Science

By the end of this course, students will be able to:

a) Design scientifically rigorous research methodologies to investigate complex environmental
b) Phenomena.
c) Critically evaluate and select appropriate quantitative and qualitative research methods and techniques for addressing specific research questions in environmental science.
d) Collect, analyze, and interpret empirical data using advanced statistical and computational tools to generate new insights into environmental processes.
e) Ability to synthesize and effectively report research findings through scholarly research.

AI & Emerging Technologies in Environmental Science

By the end of this course, students will be able to:

a) Understand the role of artificial intelligence and digital technologies in environmental monitoring, modeling, and management.
b) Apply basic AI-driven tools, data analytics, and sensor technologies to analyze environmental data and predict environmental trends.
c) Evaluate the potential and limitations of emerging technologies in addressing contemporary environmental challenges.

Analytical Techniques in Environmental Science

By the end of this course, students will be able to:

a) Apply various analytical techniques to analyze environmental samples and data effectively.
b) Demonstrate proficiency in using laboratory equipment and analytical instruments commonly used in environmental science research and monitoring.
c) Interpret analytical results and draw conclusions regarding environmental quality.

Applied Ecology

By the end of this course, students will be able to:

a) Apply ecological principles to address real-world environmental challenges and problems.
b) Identify and explain conservation and ecological issues in environment.
c) Evaluate the effectiveness of applied ecological interventions in restoring ecosystem health and resilience.

Basic Chemistry

By the end of this course, students will be able to:

a) Demonstrate an understanding of fundamental chemical concepts, including atomic structure, chemical bonding, and the periodic table.

b) Apply stoichiometry principles to balance chemical equations and calculate quantities of reactants and products in chemical reactions.
c) Analyze chemical properties and reactions of common environmental pollutants and compounds, such as organic and inorganic pollutants.

Biodiversity & Conservation

By the end of this course, students will be able to:

a) Understand the concept of biodiversity and its importance for ecosystem functioning and human well-being.
b) Identify threats to biodiversity and conservation strategies to mitigate biodiversity loss.
c) Analyze the socio-economic, cultural, and ethical dimensions of biodiversity conservation.

Climate Change

By the end of this course, students will be able to:

a) Explain the mechanisms and key drivers of climate change, including greenhouse gas emissions, deforestation etc.
b) Evaluate the impacts of climate change on ecosystems, biodiversity, human societies, and global economies.
c) Identify and assess adaptation and mitigation strategies to address climate change at local, regional, and global levels.
d) Understand major international conventions on climate change.

Climate Change Adaptation & Mitigation

By the end of this course, students will be able to:

a) Critically evaluate scientific principles, socio-economic dimensions, and sectoral vulnerabilities relevant to climate change adaptation and mitigation.
b) Apply advanced tools and models to assess the effectiveness of adaptation and mitigation strategies across diverse ecological and geographic settings.
c) Analyze international frameworks, national policies, and financial mechanisms guiding climate action, including NDCs, carbon markets, and climate finance instruments.
d) Design evidence-based, context-specific adaptation and mitigation plans for priority sectors, integrating sustainability, resilience, and equity considerations.

Disaster Risk Management

By the end of this course, students will be able to:

a) Identify and assess different types of natural and human-induced hazards, including earthquakes, floods, wildfires, industrial accidents etc.
b) Identify and explain vulnerability, exposure and resilience of communities, infrastructure, and ecosystems to various disaster risks.
c) Develop disaster risk reduction and management plans, integrating strategies such as early warning systems, land-use planning, community resilience-building initiatives etc.

Environmental Chemistry

By the end of this course, students will be able to:

a) Understand basic principles of environmental chemistry and chemical reactions.
b) Identify sources and fate of environmental pollutants.
c) Analyze the environmental implications of chemical processes and pollutants.

Environmental Economics

By the end of this course, students will be able to:

a) Understand basic economic theories and concepts.
b) Conduct the economic valuation of environmental resources and services.

c) Describe the role of economic instruments and institutions in promoting environmental conservation, sustainability and controlling pollution.

Environmental Governance

By the end of this course, students will be able to:

a) Understand basic principles of and actors involved in environmental governance, policy development, and implementation.
b) Analyze the role of international agreements, protocols and conventions in addressing environmental issues.
c) Understand and explain legal and regulatory frameworks at national (federal / provincial) and international levels for environmental protection and management.

Environmental Management Systems

By the end of this course, students will be able to:

a) Understand basic principles and components of Environmental Management Systems (EMS).
b) Describe the benefits of implementing EMS.
c) Analyze case studies of EMS implementation in various sectors.
d) Understand key regulatory and compliance requirements as applied to EMS.

Environmental Microbiology

By the end of this course, students will be able to:

a) Understand the role of microorganisms in natural ecosystems and their interactions with the environment.
b) Identify and characterize environmental microorganisms using microscopy, culture techniques, and molecular biology methods.
c) Evaluate the contributions of microorganisms to environmental processes such as nutrient cycling, bioremediation, wastewater treatment etc.

Environmental Physics

By the end of this course, students will be able to:

a) Understand basic principles of physics as applied to environmental processes.
b) Describe physical phenomena such as energy transfer, heat exchange, fluid dynamics etc. in environmental systems.
c) Analyze the role of physical processes in environmental phenomena such as climate dynamics, air pollution dispersion etc.

Environmental Pollution

By the end of this course, students will be able to:

a) Understand the types, sources, and pathways of environmental pollutants in air, water, and soil.
b) Analyze the impacts of pollution on ecosystems, human health, and climate systems.
c) Evaluate pollution control strategies, technologies, and policies for mitigating environmental contamination.

Environmental Toxicology

By the end of this course, students will be able to:

a) Understand basic principles of toxicology and the effects of environmental pollutants on living organisms.
b) Identify routes of exposure and mechanisms of toxicity for environmental contaminants.
c) Describe strategies for assessing and managing risks associated with toxicants.

Fundamentals of Ecology

By the end of this course, students will be able to:

a) Understand basic concepts and principles of ecology.

b) Describe the structure and function of ecosystems.
c) Analyze ecological relationships and interactions in natural environments.

Geographical Information Systems & Remote Sensing

By the end of this course, students will be able to:

a) Understand basic principles and applications of Geographic Information Systems (GIS) and Remote Sensing (RS) techniques.
b) Describe GIS and RS methods for collecting, analyzing, and interpreting spatial and temporal data.
c) Apply GIS and RS techniques to solve environmental problems and support decision-making.

Health, Safety & Environmental Management

By the end of this course, students will be able to:

a) Understand the principles and practices of health, safety, and environmental (HSE) management in industrial and natural settings.
b) Identify occupational hazards, environmental risks, and methods for ensuring regulatory compliance and workplace safety.
c) Develop and assess HSE management plans to promote sustainable and safe environmental practices.

Introduction to Earth Sciences

By the end of this course, students will be able to:

a) Understand basic concept structure and components of Earth's systems.
b) Describe Earth's geological features, processes, and phenomena.
c) Understand and explain interactions between Earth's systems and their implications for environmental and climatic changes.

Introduction to Environmental Science

By the end of this course, students will be able to:

a) Understand basic concepts and interdisciplinary nature of environmental science.
b) Identify major components of environment i.e. lithosphere, hydrosphere, atmosphere and biosphere, and their interactions.
c) Understand human-environment interactions and their implications for environmental management.

Mineral Resources

By the end of this course, students will be able to:

a) Understand the formation, classification, and distribution of mineral resources on Earth.
b) Analyze the environmental and socio-economic implications of mineral exploration, extraction, and use.
c) Evaluate strategies for sustainable management and conservation of mineral resources.

Principles of Biology

By the end of this course, students will be able to:

a) Demonstrate knowledge of fundamental biological concepts, including cell structure and function, genetics, evolution, and ecology.
b) Understand fundamental biological principles related to ecological relationships, population dynamics, and biodiversity patterns.
c) Understand the interconnectedness of living organisms with their environment and the impacts of human activities on ecosystems and species.

Research Methods in Environmental Science

By the end of this course, students will be able to:

a) Understand basic principles and methodologies of scientific research.

b) Describe methods for designing and conducting research projects in environmental sciences.
c) Analyze data and communicate research findings effectively.

Solid Waste Management

By the end of this course, students will be able to:

a) Identify sources, types, and composition of solid waste generated by human activities.
b) Evaluate the environmental, social, and economic impacts of solid waste generation, disposal, and recycling practices.
c) Design integrated solid waste management plans, incorporating waste reduction, recycling/resource recovery, composting, landfilling, and waste-to-energy technologies to minimize environmental pollution and resource depletion.

Strategic Environmental Assessment

By the end of this course, students will be able to:

a) Analyze and evaluate environmental policies, plans, and projects to assess their potential impact on ecosystems and communities.
b) Apply strategic thinking to identify opportunities for integrating environmental considerations into decision-making processes at various scales.
c) Develop recommendations for enhancing the sustainability and resilience of developmental plans and projects in various sectors through strategic environmental assessment.
d) Communicate effectively with stakeholders to facilitate consensus-building and informed decision-making in environmental planning and management.

Sustainable Development

By the end of this course, students will be able to:

a) Understand basic concepts and goals of sustainable development.
b) Identify and explain challenges and opportunities for sustainable development.
c) Analyze strategies for promoting environmental sustainability.

Water & Wastewater Treatment

By the end of this course, students will be able to:

a) Determine water quality parameters and characterize the composition of water and wastewater sources using standard analytical techniques.
b) Understand the principles and processes involved in water and wastewater treatment, including physical, chemical, and biological treatment methods.
c) Explain treatment efficiency, cost-effectiveness, and environmental sustainability.