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SUBJECT: REVISED CURRICULUM FOR DEGREE PROGRAMS IN REMOTE SENSING AND GIS

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 has revised the curriculum standards for Remote Sensing and GIS degree programs at NQF levels 5, 6 and 7 through National Curriculum Review Committee (NCRC). These updated curriculum standards are 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 Remote Sensing and GIS degree programs are hereby notified. Universities offering these programs are advised to align their Remote Sensing and GIS curricula with these standards as a minimum requirement. Additionally, the respective departments must develop course contents in accordance with the prescribed framework, ensuring that the programs address both national and local industry needs. The finalized course contents be submitted electronically to this office at the earliest. An electronic copy of the revised curricula is available on HEC's official website.

HIDAYATULLAH KASI

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CURRICULUM
FOR
REMOTE SENSING AND GIS
ASSOCIATE DEGREE | BS | MS
(2025)



HIGHER EDUCATION COMMISSION
ISLAMABAD – PAKISTAN

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PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic program are required to undergo to achieve some specific objectives. It includes a scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

Higher Education Commission, since its inception, has been involved in developing /revising the curricula on periodic basis through National Curriculum Revision Committees (NCRCs) comprising of eminent academics, researchers from HEC recognized universities/DAIs, professional councils, R&D organizations of repute and industry professionals. So far, HEC has developed and revised curricula of 150+ disciplines for undergraduate and graduate programs in various fields of Natural Sciences, Applied Sciences, Social Sciences, Art & Humanities, Engineering & Technology, Medical, Allied Health Sciences, Agriculture, Computing, Law, and Administration.

Over the period of time, labor markets in the world have substantially changed, hence, the demand for workforce skills has also altered. Due to these transformations, there is a need to produce well-rounded individuals who not only have the required knowledge base of specific discipline but also possess the required skills to increase their market readiness for them to contribute to the overall socio-economic development of the country. HEC has introduced the Undergraduate Education Policy 2023, which provides an overarching framework for undergraduate programs. This curriculum document is prepared in light of the UGE Policy 2023.

Dr. Amjad Hussain
Director General
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GUIDING PRINCIPLES

Minimum Standards

The curriculum standards and guidelines prescribed under this policy are mandatory at minimum level. Universities or the concerned departments may however set higher standards provided that the standards prescribed herein are not reduced or compromised.

Course Sequence, Titles and Credits

For BS and MS in Remote Sensing and GIS, the sequence of courses prescribed under this document is logically arranged and is suggestive only. The offering department may rearrange the sequence and alter the course titles and credits provided that the essence of the courses prescribed in policy remains intact. The department may add more courses as and when required subject to approval of 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. These outcomes serve as essential benchmarks, ensuring consistency in the quality of education across institutions. The CLOs prescribed herein represent the minimum level of competency and understanding expected from students. 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 policy, CLOs are exclusively developed for major field courses within the program. For interdisciplinary courses, departments offering these courses are responsible for developing their CLOs in alignment with their respective disciplines and program requirements. Moreover, CLOs for elective courses are not prescribed here, as these are advanced or specialized courses. The development of CLOs for electives is the responsibility of the respective departments, taking into account the course's advanced nature and relevance to the program. For general education courses as required under the HEC Undergraduate Education Policy V 1.1., departments may adopt the CLOs prescribed in the HEC-developed model courses.

Course Syllabus

This document serves as a comprehensive guideline describing the course learning outcomes (CLOs) for each course offered in the Associate Degree, BS and MS in Remote Sensing and GIS as minimum standards. The offering department is mandated to meticulously prepare, modify, and tailor the syllabus of each course, ensuring alignment with the stipulated learning outcomes. It is in this regard imperative that the department utilizes instructional, reference, and reading materials that it deems appropriate to effectively meet the CLOs.

General Education

For Associate degree and BS in Remote Sensing and GIS, the courses prescribed for General Education component must mandatorily be offered with the same titles and credits as prescribed under HEC Undergraduate Education Policy V 1.1. The concerned departments 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 valid for MS in Remote Sensing and GIS.

Requirement of Field Experience / Internship

It is a mandatory degree award requirement of three (03) credit hours for BS in Remote Sensing and GIS. Internship of six (06) to eight (08) weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field. This requirement cannot be substituted with additional course work, capstone or project work.

Requirement of Capstone Project

It is a mandatory degree award requirement of three (03) credit hours for BS in Remote Sensing and GIS. A capstone project is multifaceted body of work that serves as a culminating academic and intellectual experience for students. The capstone project must be supervised and graded by a faculty member as per the protocols prescribed by the concerned department. This requirement cannot be substituted with additional course work or internship.

Associate Degree in Remote Sensing and GIS

The first-four semesters of the BS Remote Sensing and GIS as prescribed in this policy are aligned with the structure of Associate Degree Program in Remote Sensing and GIS. Capstone Project and Field experience is not a mandatory requirement for the Associate Degree in Remote Sensing and GIS.

Entry and Exit Provisions at Undergraduate Level

a. Pathway for Graduates with Associate Degree

- Students having completed Associate Degree in Remote Sensing and GIS or related disciplines are allowed admission in the fifth semester of the BS in Remote Sensing and GIS.
- Students having completed Associate Degree in disciplines other than Remote Sensing and GIS and related disciplines may be offered deficiency courses from 15-18 credits through bridging semester prior to enrollment in 5th Semester of BS Remote Sensing and GIS Program. The bridging courses shall be determined by the concerned admitting department.
- The minimum eligibility for admission in the fifth semester in above cases is 2.00/4.00 CGPA in the prior qualification i.e., Associate Degree. The concerned university may, however, set higher eligibility and admission criteria for admission in the fifth semester of BS in Remote Sensing and GIS.

b. Pathway for Graduates with Conventional BSc/Equivalent Degree Programs

- Students having completed two-year conventional BSc/equivalent degree programs are allowed admission in the fifth semester of BS in Remote Sensing and GIS in which case, such students shall be required to complete deficiency courses from 15-18 credit hours through bridging semester. The bridging courses shall be determined by the concerned admitting department.
- 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 concerned university may however set higher eligibility and admission criteria for admission in the fifth semester of BS Remote Sensing and GIS.

c. **Exiting from BS in Remote Sensing and GIS with the Associate Degree**

- Students enrolled in BS Remote Sensing and GIS are allowed to exit the program with Associate Degree in Remote Sensing and GIS provided that they have completed the requirements of the first-four semesters of the BS Remote Sensing and GIS program as prescribed in this policy.

BACHELOR OF SCIENCE (BS) REMOTE SENSING AND GIS

PROGRAM DESCRIPTION

The Bachelor of Science in Remote Sensing and GIS program, structured in line with the HEC Undergraduate Education Policy V 1.1. is an interdisciplinary program that equips students with the knowledge and skills needed to analyze and interpret spatial data using advanced technologies. This program merges concepts from geography, environmental science, data analysis, and computer science to prepare graduates for careers in diverse fields such as urban planning, environmental management, disaster response, agriculture, and more.

RECOMMENDED NOMENCLATURE

For the sake of standardization, all the undergraduate degree programs (NQF level 6 qualifications) in the discipline of Remote Sensing and GIS must have the title of **“Bachelor of Science in Remote Sensing and GIS”**, and henceforth, degree programs at equivalent level with same purpose and scope having different nomenclatures shall accordingly be renamed.

The scheme of study prescribed for the four-year undergraduate degree in Remote Sensing and GIS is based on a total of six (06) Major Electives. Where the electives are adopted from within a single specialization domain, the degree will be offered as Bachelor of Science (BS) in Remote Sensing and GIS (with name of specialization) in accordance with the National Qualifications Framework (2015), and where the six courses are adopted from more than one specialization domains, the degree will be awarded as Bachelor of Science (BS) in Remote Sensing and GIS in its generic form and without any specialization.

PROGRAM LEARNING OUTCOMES

By the end of a degree in Bachelor of Science (BS) in Remote Sensing and GIS, a graduate shall be able to

- Demonstrate proficiency in using remote sensing technologies, geospatial techniques, and related tools to collect, analyze, and interpret spatial and non-spatial data.
- Process and visualize geospatial data, enabling informed decision-making and problem-solving for real-world problems in fields such as urban planning, environmental management, and disaster response etc.
- Effectively communicate complex geospatial concepts, analyses, and findings to diverse audiences through written reports, visual presentations, and oral communication.
- Demonstrate a commitment to lifelong learning and professional development by engaging in ongoing education, staying informed about technological advancements and best practices in the fields of remote sensing and GIS.
- Conduct independent research using remote sensing and GIS methodologies, demonstrating critical thinking, data collection, analysis, and report writing skills.

ELIGIBILITY CRITERIA

Higher Secondary School Certificate/A-levels (involving 12 years of schooling) or an IBCC equivalent qualification with mathematics is the eligibility requirement for admission in the BS Remote Sensing and GIS. For other candidates the admitting university shall conduct a mandatory admission test to find their suitability for admission purpose.

PROGRAM STRUCTURE

The Bachelor of Science in Remote Sensing and GIS follows HEC Undergraduate Education Policy 2023 V 1.1 provisions and comprises a minimum of 08 regular semesters (04 years). Universities may offer courses consisting of a maximum of 144 credit hours provided that the total number of credit hours are reasonably set to achieve the Program Learning Outcomes.

Minimum Credit Hours	136
General Education Courses	32 credit hours (13 courses)
Discipline Related Courses / Major	86 credit hours (29 courses)
	Major Compulsory Courses: 68 Credits (23 Courses)
	Major Electives: 18 Credits (06 Courses)
Interdisciplinary/ Allied Courses	12 credit hours (4 courses)
Field Experience/Internship	3 credit hours
Capstone Project	3 credit hours
Program Duration	Minimum: 4 Years Maximum: 6 Years (Further extendable to another year subject to the approval of the university's statutory body following the provisions of HEC Undergraduate Education Policy 2023 V 1.1)
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/repetition courses only)

3 Credit Hours (Theory)	3 classes (1 hour each) OR 2 classes (1.5 hours each) OR 1 class (3 hours) per week throughout the semester.
1 Credit Hours (Practical Work)*	1 Credit hour of practical work requires three contact hours per week throughout the semester.
Policy for Probation in Semester	<p>i) The students acquiring less than 2.00/4.00 GPA in a semester but passing in all papers will be promoted with the condition to achieve more than 2.0 GPA in the next semester and s/he will be put on probation for the next semester.</p> <p>ii) The students acquiring GPA 1.7 and above but failing in any paper(s) will be placed on probation and promoted to the next semester conditionally. They will have to be registered for summer semester to improve the grade.</p> <p>iii) Students acquiring GPA less than 1.7 in two consecutive semesters and failing in any paper(s) even after attending summer semester for one academic year will be dropped from university rolls.</p>

SCHEME OF STUDIES

The standard scheme of studies for BS in Remote Sensing and GIS is given as under:

SEMESTER I			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Quantitative Reasoning-I*	3 (3-0)	General Education
2	Functional English*	3 (3-0)	General Education
3	Applications of Information and Communication Technologies*	3 (2-1)	General Education
4	Introduction to GIS	3 (2-1)	Major
5	Introduction to Physical Geography	3 (3-0)	Major
6	IDS-I	3 (3-0)	Interdisciplinary
Total Credits (18)			

SEMESTER II			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Quantitative Reasoning-II*	3 (3-0)	General Education
2	Social Science**	2 (2-0)	General Education
3	Expository Writing**	3 (3-0)	General Education
4	Natural Science**	3 (2-1)	General Education
5	Introduction to Remote Sensing	3 (2-1)	Major
6	Map work and Projections	3 (2-1)	Major
Total Credits (17)			

SEMESTER III			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Arts and Humanities**	2 (2-0)	General Education
2	Islamic Studies (Religious Education / Ethics for non-Muslim students) *	2 (2-0)	General Education
3	Pakistan Studies*	2 (2-0)	General Education
4	Land Surveying	3 (2-1)	Major
5	Digital Image Processing	3 (2-1)	Major
6	Global Navigation Satellite System	3 (2-1)	Major
7	IDS-II	3 (3-0)	Interdisciplinary
Total Credits (18)			

SEMESTER IV			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Civics and Community Engagement*	2 (2-0)	General Education
2	Ideology and Constitution of Pakistan*	2 (2-0)	General Education
3	Entrepreneurship*	2 (2-0)	General Education
4	Active Remote Sensing	3 (2-1)	Major
5	Photogrammetry	3 (2-1)	Major
6	Digital Cartography	2 (1-1)	Major
7	Spatial Data Analysis	3 (2-1)	Major
Total Credits (17)			

* The student may Exit with Associate Degree in Remote Sensing and GIS after completion of 04 Semesters in Remote Sensing and GIS four year degree program.

SEMESTER V			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	IDS-III	3 (3-0)	Interdisciplinary
2	IDS-IV	3 (3-0)	Interdisciplinary
3	Spatial Data Infrastructure and Standardization	3 (3-0)	Major
4	Mobile Data Acquisition and Mapping	3 (2-1)	Major
5	GIS Programming and Customization	3 (2-1)	Major
Total Credits (15)			

SEMESTER VI			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Research Methodology	3 (3-0)	Major
2	Spatial Decision Support Systems	3 (3-0)	Major
3	Spatial Databases	3 (2-1)	Major
4	Hyperspectral Remote Sensing	3 (2-1)	Major
5	Elective-I***	3 (3-0)	Major
6	Elective-II***	3 (3-0)	Major
Total Credits (18)			

SEMESTER VII			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Web GIS	3 (2-1)	Major
2	Artificial Intelligence in RS and GIS	3 (2-1)	Major
3	Spatial Data Modelling	3 (2-1)	Major
4	Elective-III***	3 (3-0)	Major
5	Elective-IV***	3 (3-0)	Major
Total Credits (15)			

SEMESTER VIII			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Unmanned Aerial Vehicle and Data Processing	3 (2-1)	Major
2	Machine Learning in Spatial Data	3 (2-1)	Major
3	Elective-V***	3 (3-0)	Major
4	Elective-VI***	3 (3-0)	Major
5	Capstone Project	3 (3-0)	Capstone Project
Total Credits (15)			

- Note:** Internships of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.
- * The university may use HEC-designed model courses.
 - ** The university/offering department may offer any course within the broader subject domain/cluster to meet the given credits.
 - *** The university/offering department may offer any advanced course in Remote Sensing and GIS as an elective based on available academic and physical resources, depending on its geographical location and program objectives.

RECOMMENDED LIST OF INTERDISCIPLINARY COURSES:

Student may opt interdisciplinary courses from the following list where required in the scheme of studies for BS in Remote Sensing and GIS, to complement their holistic understanding of the major, provided that the same is allowed by the admitting department. The list provided here is a recommended one only, and the offering department may add more courses as and when needed, provided that the same is approved by the university's relevant statutory body.

1. Geography of Pakistan
2. Introduction to Human Geography
3. Introduction to Programming
4. Data Structure and Algorithms
5. Introduction to Environmental Science
6. Geology
7. Geomorphology
8. Meteorology
9. Climatology
10. Economics and Sustainable Development
11. Disaster Management and Risk Assessment
12. Project Management

SPECIALIZATIONS IN BS REMOTE SENSING AND GIS:

1. **Natural Resource Management (Any 06 Electives)**
 - i. Introduction of GIS in Natural Resources Management
 - ii. Spatial Data Analysis for Natural Resources
 - iii. GIS for Forest and Biodiversity Conservation
 - iv. GIS for Watershed and Water Resources Management
 - v. Land Use and Land Cover Change Analysis
 - vi. GIS for Soil Resource Mapping and Sustainable Land Management
 - vii. GIS in Climate Change Impact Assessment
 - viii. GIS in Mineral Exploration
 - ix. GIS for Hydrocarbon Exploration
2. **Urban and Regional Planning (Any 06 Electives)**
 - i. Urban and Regional Planning
 - ii. Land Use Planning and Zoning Regulations
 - iii. Geospatial Analysis for Urban Planning
 - iv. Sustainable Cities and Environmental Planning

- v. Transportation Planning and Infrastructure Development
 - vi. Urban Economics and Policy Analysis
 - vii. Community Engagement and Participatory Planning
 - viii. Resilient Cities and Disaster Risk Management
 - ix. Infrastructure planning
- 3. Science of Climate Change (Any 06 Electives)**
- i. Fundamentals of Climate Science and Global Change
 - ii. Climate Change Monitoring with Remote Sensing
 - iii. Climate Modeling and Future Projections
 - iv. GIS for Climate Risk and Vulnerability Assessment
 - v. Remote Sensing of Atmospheric Changes and Air Pollution
 - vi. Water Resource Management and Climate Change
 - vii. Land Use and Land Cover Change in a Changing Climate
 - viii. Coastal and Oceanic Climate Change Impacts
 - ix. Climate Change Policy, Adaptation, and Mitigation Strategies
 - x. Geospatial Techniques for Disaster Risk Reduction and Climate Resilience
- 4. Spatial Data Science (Any 06 Electives)**
- i. Introduction to Spatial Data Science
 - ii. Spatial Data Visualization
 - iii. Geospatial Data Acquisition and Management
 - iv. Spatial Statistics and Geospatial Modeling
 - v. Big Data and Cloud Computing for Spatial Analysis
 - vi. Machine Learning for Spatial Data
 - vii. Geospatial Time Series Analysis
 - viii. Advanced Remote Sensing Data Analysis
 - ix. Spatial Network Analysis and Modeling
 - x. Geospatial Data Science for Urban Analytics
- 5. Spatial Business Intelligence (Any 06 Electives)**
- i. Geospatial Business Intelligence and Decision Support Systems
 - ii. Location Intelligence and Market Analysis
 - iii. Supply Chain Optimization and Logistics GIS
 - iv. Smart Cities and Urban Business Analytics
 - v. Geospatial Financial and Risk Analytics
 - vi. Social Media and Geospatial Business Trends
 - vii. Artificial Intelligence and Machine Learning in Business GIS
 - viii. GIS for Retail and Real Estate Market Intelligence
 - ix. Cloud Computing and Mobile GIS for Business Applications
 - x. Capstone in Geospatial Intelligence
- 6. Disaster Risk Management (Any 06 Electives)**
- i. Disaster Risk Management and GIS
 - ii. Remote Sensing for Hazard Assessment and Monitoring
 - iii. Geospatial Technologies for Disaster Preparedness and Early Warning Systems
 - iv. Spatial Data Analysis for Risk and Vulnerability Mapping
 - v. Drone and Satellite Applications in Disaster Response and Recovery
 - vi. Multi-Hazard Risk Assessment Using GIS and Remote Sensing
 - vii. Big Data and AI for Disaster Prediction and Impact Analysis

- viii. Geospatial Decision Support Systems for Emergency Management
- ix. Climate Change and Disaster Resilience Planning with GIS

7. Precision Agriculture (Any 06 Electives)

- i. Introduction to GIS in Agriculture
- ii. Precision Agriculture and Geospatial Technologies
- iii. Soil Fertility Mapping and Land Suitability Analysis
- iv. Remote Sensing for Crop Monitoring
- v. Climate and Weather Analysis for Agriculture
- vi. Irrigation Management and Water Resource Mapping
- vii. Pest and Disease Monitoring and Mapping
- viii. Smart Farming and IoT-Enabled GIS Applications
- ix. Variable Rate Technology

8. Geospatial App Development (Any 06 Electives)

- i. Introduction to GIS Programming and Automation
- ii. Spatial Databases and Geodatabase Management
- iii. Geospatial Analysis and Automation
- iv. API Development for Web Mapping
- v. Mobile GIS and Location-Based Services Development
- vi. 3D GIS and Augmented Reality Applications
- vii. Full-Stack GIS Application Development
- viii. Advanced Web Mapping Technologies

Clarification: Students specializing in a field, taking 18 credits (6 courses) of electives, may also choose interdisciplinary courses, a capstone project, field experience, and one additional minor within the same field. This combination fulfills requirements for a second major, if needed, for equivalency purposes.

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for the award of a Bachelor of Science (BS) in Remote Sensing and GIS:

- a) All courses in the General Education category must be completed as prescribed by HEC Undergraduate Policy 2023 V 1.1.
- b) As prescribed in this policy, a minimum of 136 credit hours must be completed in a minimum of 08 semesters spread over a minimum of four years.
- c) The capstone project (03 credit hours) must be completed following HEC-prescribed guidelines for the degree award. This requirement cannot be substituted with additional coursework.
- d) Internships of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.
- e) CGPA must not be below 2.00/4.00 at the 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 eight (08) regular semesters spread over four (04) years. The maximum duration may be extended to two (02) more semesters / one

(01) year in extraordinary circumstances, subject to the approval of the university's relevant statutory body. The summer semester is not considered a regular semester.

Guidelines:

1. The listed specializations and courses are not exhaustive. Higher Education Institutions (HEIs) are encouraged to offer additional specializations and/or courses, if available. It's essential to note that all BS Remote Sensing and GIS degrees, regardless of specialization, are considered equivalent under this scheme of studies. There is no inherent difference between them. However, employers may prefer specific specializations, depending on their requirements.
2. All previous degrees with varying nomenclature such as Remote Sensing, GIS, Geoinformatics and Geomatics, are deemed equivalent to a 16-year schooling BS in Remote Sensing and GIS regardless of the degree title.
3. It is noteworthy that universities can redistribute courses across the first four and last four semesters. This adjustment can be made based on factors such as teaching staff availability and other facilities. The course distribution outlined is not rigid and is subject to modification by the concerned universities.
4. All universities are directed to implement this revised scheme of studies and align their degree programs accordingly, effective Fall 2025. As of this date, degrees with previous nomenclatures will no longer be recognized or accepted for attestation; only Bachelor of Science in Remote Sensing and GIS will be acceptable.

MASTER OF SCIENCE IN REMOTE SENSING AND GIS

PROGRAM DESCRIPTION

The Master of Science in Remote Sensing and GIS is structured in accordance with the HEC Graduate Education Policy 2023 and is designed to provide students with a rigorous and in-depth understanding of advanced theories, concepts, and methodologies in the field of Remote Sensing and GIS.

The Master of Science in Remote Sensing and GIS is designed for students with study of geospatial analysis. It has specialized training in the use of remote sensing and GIS in environmental and natural resource analysis and management. Students are trained for careers in the private, public, and nonprofit sectors where there is high demand for professionals with advanced technical skills who can organize and analyze spatial data.

STANDARD NOMENCLATURE

To ensure uniformity, the standard nomenclature of all graduate degree programs (NQF-7) in Remote Sensing and GIS is recommended to be **"Master of Science in Remote Sensing and GIS"**

To ensure parity and equity, it is clarified that previously awarded MPhil degrees in Remote Sensing and GIS, with 18 years of schooling, will be considered equivalent to the MS degree. No discrimination will be made against holders of either degree title, and both will be recognized as having equal academic standing.

PROGRAM LEARNING OUTCOMES

By the completion of a Master of Science (MS) in Remote Sensing and GIS, the graduates will be able to:

- Demonstrate advanced skills in remote sensing technology and GIS software, including data acquisition, processing, analysis, and visualization techniques to address complex spatial problems.
- Analyze and interpret remote sensing data and geographical information to extract meaningful insights and support decision-making processes across various applications such as urban planning, environmental monitoring, and disaster management.
- Employ appropriate research methodologies and statistical techniques to design and conduct original research in remote sensing and GIS, and effectively communicate findings through written reports and presentations.
- Apply critical thinking and problem-solving skills to assess geographical and environmental issues, devise innovative solutions, and contribute to sustainable development and resource management.
- Work collaboratively in interdisciplinary teams, demonstrating effective communication and project management skills, to integrate remote sensing and GIS with other fields such as ecology, urban studies, and public health.
- Understand and apply ethical considerations in geospatial data collection and analysis, including issues related to privacy, data ownership, and the societal impacts of GIS and remote sensing technologies.

- Exhibit a commitment to lifelong learning by staying current with emerging technologies, methodologies, and trends in remote sensing and GIS, and demonstrate adaptability in applying new knowledge to real-world challenges.

ELIGIBILITY CRITERIA

- a) An undergraduate degree (involving 16 years of education) in Remote Sensing and GIS or relevant field is the basic eligibility requirement for admission to the Master of Science (MS) in Remote Sensing and GIS. The offering department shall determine relevance of the prior qualification in this regard.
- b) In addition to the basic eligibility, the admitting university 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 admitting university 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 Master of Science (MS) in Remote Sensing and GIS is structured in accordance with the provisions of the HEC Graduate Education Policy (GEP-2023). The standard structure of the program is as under:

Minimum Credit Hours	30
Course Work	Minimum 24 credit hours (8 courses)
Research Work / Thesis	Minimum 06 credit hours
Program Duration	<p>Minimum: 1.5 Years (3 regular semesters)</p> <p>Maximum: 4 Years (8 regular semesters)</p> <p>Note:</p> <p>If a student cannot secure an MS within the prescribed timeframe and claims an extension in duration, the university may constitute an appropriate authority to determine the causes of the delay. In the event of force majeure (i.e., delay on account of circumstances beyond the control of the student), the university may grant an extension in the period of award of the 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.</p>
Semester Duration	<p>16-18 weeks for regular semesters (1-2 weeks for examination)</p> <p>8-9 weeks for summer semesters (1 week for examination)</p>
Course Load (per semester)	<p>09-12 credit hours for regular semesters</p> <p>Up to 8 credit hours for summer semesters</p>

	(for remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)	3 classes (1 hour each) OR 2 classes (1.5 hours each) OR 1 class (3 hours)
1 Credit Hours (Practical Work)	1 credit hour of practical work requires three contact hours per week throughout the semester.

SCHEME OF STUDIES:

The standard scheme of studies for Master of Science (MS) in Remote Sensing and GIS is given below:

SEMESTER I			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Advanced GIS*	3	Core
2	Advanced Remote Sensing and Digital Image Processing*	3	Core
3	Elective – I **	3	Elective
4	Elective – II **	3	Elective
Total Credits (12)			

SEMESTER II			
S. No	COURSE	CREDIT HOURS	CATEGORY
1	Advanced Research Methods*	3	Core
2	Advanced Geodatabase and Programming*	3	Core
3	Elective – III **	3	Elective
4	Elective – IV **	3	Elective
Total Credit Hours (12)			

SEMESTER III			
S.N.	COURSE	CREDIT HOURS	CATEGORY
	Thesis ***/Course Work	6 ****	Research

SEMESTER IV			
S.N.	COURSE	CREDIT HOURS	CATEGORY
	Thesis ***/ Course Work	Continued	Research

* These are core mandatory courses for the program.

** The university/offering department may offer any advanced course in Remote Sensing and GIS as an **elective**, where required, as per its program objectives, the university's geographical location, and available academic and faculty resources. Credit combination (reflecting a balance of theory and lab/field work) must be arranged in accordance with the nature of the course.

*** Research work for a thesis must be performed by students individually as per the university's policy, including but not limited to the protocols for topic selection, allocation of supervisor and co-supervisor (where required), thesis submission, defense, and evaluation as approved through its statutory bodies.

**** Credit hours for research work/thesis may be increased (above 6 credit hours) subject to the approval of the university's relevant statutory body.

LIST OF ELECTIVE COURSE:

Below is the recommended list of major elective courses for MS Remote Sensing and GIS. The department concerned may offer any four (04) courses from the following list or any other course relevant to the specialization of Remote Sensing and GIS, as per the availability of academic resources:

1. Remote Sensing applications in Urban areas
2. GIS in Agriculture and Natural Resources
3. Marine Remote Sensing
4. Spatial Cloud Computing
5. Climate change Mitigation and adaptation
6. Disaster Risk Reduction
7. Spatial Hydrology
8. Special topics in GIS
9. Special topics in RS
10. Spatial Epidemiology
11. Hydrology and Water Resources
12. Geostatics
13. Fluvial Morphology
14. Applied Geomorphology
15. Land Information System
16. Spatial Data Infrastructure
17. Spatial decision support system
18. Food security and Climate Change
19. Advanced Web GIS

20. GIS for Health Services
21. GIS for Education Services
22. GIS for Tourism development
23. Spatial Statistics
24. Geo Artificial Intelligence
25. Deep Learning in GIS
26. Geo-visualization
27. Remote Sensing of Cryosphere
28. GIS for energy management
29. Soil Geomorphology
30. Utilities and service management
31. Climate Data modeling
32. Digital earth and data science
33. Airborne and terrestrial lidar
34. Climate Data Mining and Analysis
35. Remote Sensing in Archeology

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for the award of a Master of Science (MS) in Remote Sensing and GIS:

- a) A minimum of twenty-four (24) credit hours, including twelve (12) credit hours for core courses and twelve (12) credit hours for elective courses as prescribed in this policy document, must be completed.
- b) In addition to the twenty-four (24) credit hours of coursework, research work/thesis of a minimum of six (06) credit hours must also be completed individually as partial fulfillment of the degree program.
- c) CGPA must not be below 2.50/4.00 at the time of completion of the degree program. The university may, however, set higher standards in this regard.
- d) The minimum duration required to complete the degree is three (03) regular semesters, which may be extended to eight (08) regular semesters. The summer semester is not considered a regular semester.

COURSE LEARNING OUTCOMES

For BS and MS Remote Sensing and GIS

Introduction to Physical Geography

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

- Comprehend the nature and scope of Physical Geography
- Have knowledge of basic concepts, physical processes and principles of the subject
- Know various terms employed in understanding of different physical features.
- Identify local landforms

Map Work and Projections

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

- Describe the fundamental principles of map making
- Produce maps with basic cartographic techniques
- Develop real world globe on paper with the help of map projections.
- Capable of mapping on Large scale.

Land Surveying

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

- Conduct land survey.
- Identify the overall process of designing a land surveying
- Analyze quantitative and qualitative data.
- Develop quality maps with softwares.

Digital Cartography

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

- Understand and design thematic maps.
- Explore and devise strategies to achieve good contrast, figure/ground relationships, and color harmony.
- Apply cartographic language.

Research Methodology

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

- Understand the nature and purpose of the research.
- Identify and access resources, such as journals and databases for research.
- Write the research proposal and conduct pure and applied studies.
- Familiar with a wide range of quantitative research techniques and approaches.

Advanced Research Methods

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

- Develop the ability of concept formation and integrate it into a research design
- Demonstrate the link between a research question, research method and selection of sources
- Write methodologically sound research designs of academic quality
- Make oral and written methodological criticisms on others' research designs.

Introduction To GIS

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

- Explain the fundamental principles of GIS.
- Utilize GIS software to collect, analyse and visualize spatial data.
- Perform basic spatial analysis techniques.

Spatial Data Analysis

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

- Apply spatial statistics and analytical methods to explore patterns, relationships, and trends in geospatial data for decision-making.
- Utilize GIS and statistical tools to perform spatial interpolation, clustering, regression, and modelling for complex spatial datasets.
- Integrate spatial analysis techniques to solve real-world problems.

Spatial Data Infrastructure and Standardization

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

- Understand the principles and components of Spatial Data Infrastructure (SDI) and its role in facilitating geospatial data sharing and accessibility.
- Apply international standards and protocols for geospatial data exchange, metadata, and interoperability within SDI frameworks.
- Design and implement SDI solutions for real-time data integration, access, and distribution to support decision-making in various sectors.

Mobile Data Acquisition and Mapping

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

- Utilize mobile GIS and GPS technologies to collect, process, and manage spatial data for real-time mapping and decision-making applications.
- Apply field data acquisition techniques using UAVs, GNSS, and mobile sensors to enhance spatial accuracy and geospatial data integration.
- Develop and implement mobile mapping solutions for navigation, infrastructure monitoring, disaster response, and location-based services.

Spatial Decision Support Systems

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

- Apply spatial data models and decision-making frameworks to develop GIS-based solutions for complex spatial planning and management challenges.
- Utilize Multi-Criteria Decision Analysis (MCDA) and geospatial tools to assess, prioritize, and optimize spatial decisions in various applications.
- Design and implement Spatial Decision Support Systems (SDSS) for real-world problems in urban planning, environmental management, and disaster response.

Spatial Databases

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

- Design and implement spatial databases using relational and SQL database management systems for efficient geospatial data storage and retrieval.
- Apply spatial SQL and indexing techniques to query, manipulate, and optimize large-scale spatial datasets for GIS applications.

- Integrate spatial databases with remote sensing and GIS tools to support spatial analysis, decision-making, and real-time geospatial applications.

Spatial Data Modelling

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

- Develop conceptual, logical, and physical models for representing spatial data using vector, raster, and object-based approaches.
- Apply geospatial data structures and topological rules to ensure accuracy, consistency, and efficiency in spatial databases and GIS applications.
- Integrate spatial data modelling techniques with remote sensing and GIS tools to support spatial analysis, decision-making, and real-world problem-solving.

Advanced GIS

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

- Apply advanced spatial analysis techniques such as network analysis and geostatistics, to solve complex geospatial problems.
- Utilize advanced level GIS tools and automation including scripting, model building, and cloud-based GIS for efficient spatial data processing and analysis.
- Integrate multi-source geospatial data from remote sensing, IoT, and real-time sensors to develop dynamic GIS applications for decision support.

Hyperspectral Remote Sensing

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

- Explain the principles of hyperspectral imaging, sensor technologies, spectral reflectance properties, and their applications in Earth observation.
- Acquire, preprocess (radiometric, geometric, and atmospheric corrections), and analyze hyperspectral datasets using spectral feature extraction, and classification techniques.
- Utilize hyperspectral data for advanced applications in agriculture, geology, forestry, water resource management, environmental monitoring, and disaster assessment, integrating GIS and decision-making tools.

Photogrammetry

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

- Explain the fundamentals of aerial and terrestrial photogrammetry, camera models, stereoscopic vision, and image orientation.
- Acquire aerial/UAV imagery, apply geometric corrections, generate DEMs, orthophotos, and extract spatial features.
- Utilize photogrammetric techniques for topographic mapping, urban planning, infrastructure monitoring, and GIS integration.

Active Remote Sensing

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

- Explain the fundamentals of LiDAR, RADAR, SONAR and SONODAR, including signal transmission, backscatter properties, and sensor configurations.
- Acquire, preprocess, and interpret LiDAR point clouds, SAR imagery, and waveform data for terrain mapping and object detection.
- Utilize LiDAR and SAR for topographic mapping, disaster assessment, vegetation monitoring, infrastructure planning, and 3D modeling.

Digital Image Processing

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

- Explain image acquisition, enhancement, filtering, transformation, and classification techniques for remote sensing applications.
- Perform radiometric and geometric corrections, feature extraction, and image classification different approaches.
- Utilize image processing techniques for land cover mapping, environmental monitoring, disaster assessment, and urban planning.

Introduction to Remote Sensing

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

- Explain the history, fundamentals of remote sensing, electromagnetic spectrum interactions, and sensor characteristics for Earth observation.
- Differentiate between satellite, airborne, and UAV-based sensors, including optical, thermal, and microwave remote sensing technologies.
- Perform radiometric and geometric corrections, image enhancement, and spectral analysis to extract meaningful geospatial information.

Advanced Remote Sensing and Digital Image Processing

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

- Perform image fusion, object-based image analysis (OBIA) for accurate feature extraction using multispectral, hyperspectral, LiDAR, and SAR.
- Implement atmospheric, radiometric, and geometric corrections to improve data accuracy and reliability.
- Utilize classification techniques for remote sensing data processing and change detection.

Unmanned Aerial Vehicle (UAV) and Data Processing

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

- Explain UAV fundamentals, including hardware, sensors, flight mechanics, and different UAV platforms.
- Plan and execute UAV missions, ensuring compliance with regulatory and safety protocols.
- Process and analyze UAV data, generating orthomosaics, DSMs, and extracting geospatial insights.
- Apply UAV data for real-world applications in agriculture, forestry, disaster management, and infrastructure monitoring.

Machine Learning in Spatial Data

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

- Explain machine learning fundamentals and differentiate between supervised, unsupervised, and reinforcement learning.
- Preprocess and integrate spatial datasets with machine learning models for geospatial analysis.
- Develop, evaluate, and optimize machine learning models for spatial applications such as land cover classification and urban modeling.
- Address ethical, computational, and performance challenges in applying machine learning to spatial data.

Artificial Intelligence in Remote Sensing and GIS

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

- Explain AI concepts, including machine learning, deep learning, and computer vision, in geospatial sciences.
- Preprocess remote sensing and GIS data for AI applications using spatial databases and big data frameworks.
- Implement AI techniques for classification, object detection, and predictive modeling in geospatial contexts.
- Evaluate ethical concerns, interpretability, and computational considerations in AI-driven geospatial solutions.

Web GIS

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

- Explain Web GIS architecture and differentiate between client-server, cloud-based, and distributed frameworks.
- Develop and deploy interactive web mapping applications using modern web technologies and GIS platforms.
- Manage and publish geospatial data through spatial databases and web map services.
- Integrate Web GIS with cloud and big data technologies for scalable spatial analysis.

GIS Programming and Customization

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

- Explain GIS programming fundamentals and differentiate between scripting and compiled languages for GIS development.
- Develop Python-based GIS applications for data automation, analysis, and customization.
- Implement spatial databases and web services for efficient GIS data management.
- Optimize GIS performance and automation through advanced scripting and parallel computing.

Global Navigation Satellite System

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

- Explain GNSS principles, signal structures, and positioning techniques.
- Process GNSS data for geospatial applications using post-processing and real-time positioning methods.
- Integrate GNSS with remote sensing and GIS for mapping, navigation, and spatial analysis.
- Address GNSS errors, limitations, and ethical considerations in positioning and tracking.

Advanced Geodatabase and Programming

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

- Explain geodatabase concepts, structures, and advantages in GIS applications.
- Design and implement advanced geospatial databases using SQL and indexing strategies.
- Automate geodatabase management through Python scripting and GIS software integrations.
- Optimize geodatabase performance and scalability for large-scale spatial data applications.