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The University Senate of Michigan Technological University
Proposal 8-25

Establishment of a New Graduate Certificate in Remote Sensing for Natural Resources

Submitted by:
College of Forest Resources and Environmental Science

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<u>**Basic Program Information**</u>
Primary Contact: Parth Bhatt, Assistant Teaching Professor; David Flaspohler, Dean and Professor, College of Forest Resources and Environmental Science

Program/Degree Type: Certificate

Program Title: Remote Sensing for Natural Resources

Planned Implementation Date: Spring 2026

Program location/modality: Online Asynchronous

Target student population: Graduates and Working Professionals

1.General Description and Characteristics of the program

1.1. General Description: The courses included in this new online certificate currently exist and have been taught for a decade as in-person classes. This proposal describes the third of three planned certificates that together can be stacked to comprise an online MGIS degree. Alternatively, individuals can take one certificate alone to boost their knowledge and skills.

The objectives of the Graduate Certificate in Remote Sensing for Natural Resources are:

a) Design and offer a sequence of courses that will enable natural resource professionals and students to develop and expand their expertise in remote sensing.

b) Facilitate hands-on experience in geographic information science applications that will empower natural resource professionals and students to successfully carry out and complete advanced GIS projects and/or pursue a Master's in GIS or another graduate degree.

c) Equip students with industry-standard skill sets and prepare them for real-world geospatial applications.

1.2 Catalog Description: The Certificate in Remote Sensing for Natural Resources provides an overview of the skills needed to be successful in collecting, processing, and analyzing remotely sensed imagery and other datasets used in natural resources management and research. The certificate includes lectures and computer laboratories. The certificate will also teach students the advanced coding skills necessary to automate and effectively perform certain Remote Sensing analyses. The Graduate Certificate Foundations in Geographic

Information Science for Natural Resources or any equivalent GIS course previously taken is recommended as a prerequisite to this certificate.

2. Rationale for the Certificate

Over the last decade, CFRES has experienced sustained growth, resulting in an increasingly large and diverse graduate student community. In the era of big data, the need for mapping data and spatial analysis is escalating. This proposed certificate program in Geographic Information Systems (GIS) is designed to equip students and professionals with advanced remote sensing, data processing, and automation skills. It will open new doors for CFRES and MTU, attracting a diverse global community to take advantage of and advance their careers in a wide variety of areas.

For current students, this certificate will enhance their graduate degree program by integrating a technological dimension. It will provide them with a competitive edge in the job market by broadening their skill set.

For professionals, this certificate serves as a platform for skill enhancement and career enrichment in remote sensing. It can be utilized as a stepping stone for career advancement, enabling them to secure new positions or pivot their career trajectory. For example, one of the classes in the second certificate (Python Programming for ArcGIS Pro) was offered as a short 7-week non-credit online course during the Fall of 2023, Spring, Summer, and Fall of 2024 to test the market and had a total of over 50 working professionals enrolled from various parts of US, which shows the high demand of online higher education.

Remotely sensed data are useful for visualizing and analyzing data from natural systems. As technology becomes more advanced, the detail and amount of data have increased exponentially. This has increased the demand for people who can organize, evaluate, and interpret large amounts of remotely sensed data. This certificate holds additional value as it can be incorporated into a Master of Geographic Information Science degree program (as well as an accelerated master's program), providing a seamless transition for those interested in further academic pursuits in this field. This proposal aims to cater to the growing demand in the GIS and remote sensing sector and provide comprehensive training for the next generation of GIS professionals. (See Fig. 1)

3. Related Online Programs: within MTU and at other Institutions

3.1 The College of Forest Resources and Environmental Science (CFRES) at Michigan Tech currently offers:
- Graduate Certificate - Foundations in Geographic Information Science for Natural Resources (Graduate Certificate)
- Python for Modern GIS and Remote Sensing (non-credit)

3.2 Other Institutions:
- Geographic Information Science and Technology-University of Southern California
- Post Baccalaureate Certificate in Geographic Information Systems-Penn State

- GIS Fundamentals Certificate-University of Wisconsin-Madison
- Geographic Information Systems Online Certificate-Lawrence Technological University

The certificate and the proposed MGIS Online degree at CFRES are distinguished primarily by their exclusive focus on forestry, natural resource management, conservation, and environmental science, unlike the broader programs from others. It closely aligns in structure with some of the existing programs. The certificates in CFRES have been developed closely with GIS industry-led experts as well as improved based on the inputs from previous alumni working as GIS analysts. Additionally, CFRES will foster distinct collaborations and funding opportunities, leveraging partnerships with entities like Michigan DNR, other state agencies, and private industries.

4. Projected Enrollments

Enrollment in the in-person MGIS program has increased from 9 to 15 students. We anticipate that with the introduction of the online program this number will grow significantly over time and enhance the institution's role as a leader in the online GIS education sector in the upper Midwest and in the US.

The proposed certificate aims to attract a growing segment of students interested in GIS, Remote Sensing, and Natural Resources. With an increasing societal emphasis on environmental sustainability, forest management, conservation, climate change, precision agriculture, and wildlife conservation, there is a heightened interest among students in these fields. This program is strategically designed to cater to this burgeoning interest, offering specialized curriculum and project opportunities that align with the challenges of our time.

Table 1 shows estimated minimum targets assuming a more aggressive marketing approach is deployed. The enrollment cap depends on the number of sections that can be allocated to each course.

Table 1. Estimated minimum enrollment targets by year.

Academic Year	Estimated Minimum Enrollment Targets
	On-Line
2025-2026	1
2026-2027	2
2027-2028	4
2028-2029	6
2029-2030	10

5. Specialized Accreditation Requirements
None.

6. Professional Licensure Requirements
This is not a licensed profession.

7. Scheduling Plans
Online sections will be implemented asynchronously through a separate section of the course on Banweb.

8. Curriculum Details
The required and elective course list is shown below with the descriptions given below. All courses below have been offered face-to-face for several years and will be revised to be offered asynchronously online starting Spring 2026.

Required Courses – 9 credits
FW5540 Advanced Terrestrial Remote Sensing 3 cr (Fall)
FW5541 Remote Sensing of the Environment (Lab) 1 cr (Fall)
FW5560 Digital Image Processing 4 cr (Spring)
FW5801 Seminar in GIS 1 cr (Fall, Spring)

New Course Descriptions
N/A - no new courses are being proposed.

9. Model Schedule Demonstrating Completion Time
The minimum completion time for online asynchronous students is two semesters with the current scheduling and the maximum time is three semesters. A typical schedule is shown below.

Semester	Course	Credits	Pre-reqs	Co-req
1 - Fall, Summer	FW5540, FW5541 - Advanced Terrestrial Remote Sensing, Remote Sensing of the Environment (Lab)	4	FW5550*	NA
2 - Spring	FW5560 Digital Image Processing	4	FW5540	NA
	FW5801 - Seminar in GIS	1	NA	FW5550

*Note: Graduate Certificate Foundations in Geographic Information Science for Natural Resources or any equivalent GIS course previously taken is recommended as a prerequisite to this certificate.

10. Library and Other Learning Resources
Students will have access to MTU Software Center to download the required class software, as well as MTU Library's online resources.

Faculty Information
11. Faculty Qualifications
The associated faculty and the certificate courses they have taught previously are given below. All of these faculty meet the standards of Senate Procedure 116.1.1, or will have completed the required training by Summer 2025.

Name	Role	Role Detail
Parth Bhatt, Graduate Faculty	MGIS Online Program Director, Assistant Teaching Professor/Researcher (FW5540, FW5541, FW5560, FW5801)	https://www.mtu.edu/forest/about/faculty-staff/faculty/bhatt/

12. Equipment
No additional equipment will be needed. MTU, CFRES, has the required licenses for all of the software used in the three classes. Access to additional computing power and storage (SSD) may be needed for students depending on enrollment, however, lab fees should cover any other additional costs.

13. Program Costs
The most significant new cost to developing and administering this certificate is the salary for a teaching professor and this has been committed by the CFRES Dean. Costs will be incurred for developing the online content, but this should be covered by CFRES. Some additional funds will be spent on creating a space for the instructor to have video/audio conversations with students in a sound-dampened environment with a higher-quality camera and microphone. The Dean had committed funds to support this new space.

Besides the above-mentioned funds, some funds will be required to market this program, at the moment the instructor is utilizing free, open-source platforms (i.e., LinkedIn, Listservs) to market the first approved MGIS Certificate along with the help of MTU Global Campus.

14. Space
No additional space is required at the University or College level to support this program.

15. Policies, Regulations, and Rules
The responsibility for administration of the program will reside with the Graduate Program Director, and Graduate Program Assistant (CFRES) who report to the CFRES Dean.

16. Learning Goals and Assessment Plans

The Graduate Learning Objectives (GLO) of the certificate are listed below with the mapping to assessment points shown in Table 2.

GLO1: Upon completion of this certificate, students will achieve advanced proficiency in visualizing, processing, analyzing, and managing large remotely sensed data through the application of industry-standard GIS and Remote Sensing software, including ArcGIS Pro, ArcGIS Online, ERDAS IMAGINE, Google Earth Engine, QGIS, and others, alongside advanced programming techniques like Python and JAVA. They will gain expertise in sophisticated Remote Sensing concepts and methodologies, enabling the analysis of large and complex datasets, the automation of routine remote sensing tasks, and the effective management of raster datasets. Furthermore, students will cultivate expertise in designing, executing, and communicating comprehensive remote sensing projects. These skills will empower them to address real-world challenges, deliver innovative solutions, and excel in professional and industry-level remote sensing analyst roles.

GLO2: Graduate students will demonstrate the ability to integrate and apply advanced technical, analytical, and problem-solving skills specific to the remote sensing field by designing, executing, and evaluating real-world projects and research initiatives. They will utilize industry-standard tools, methodologies, and best practices to produce actionable solutions, effectively communicate their findings, and contribute to the advancement of knowledge within their discipline.

Table 2. Mapping of GLO to assessment points.

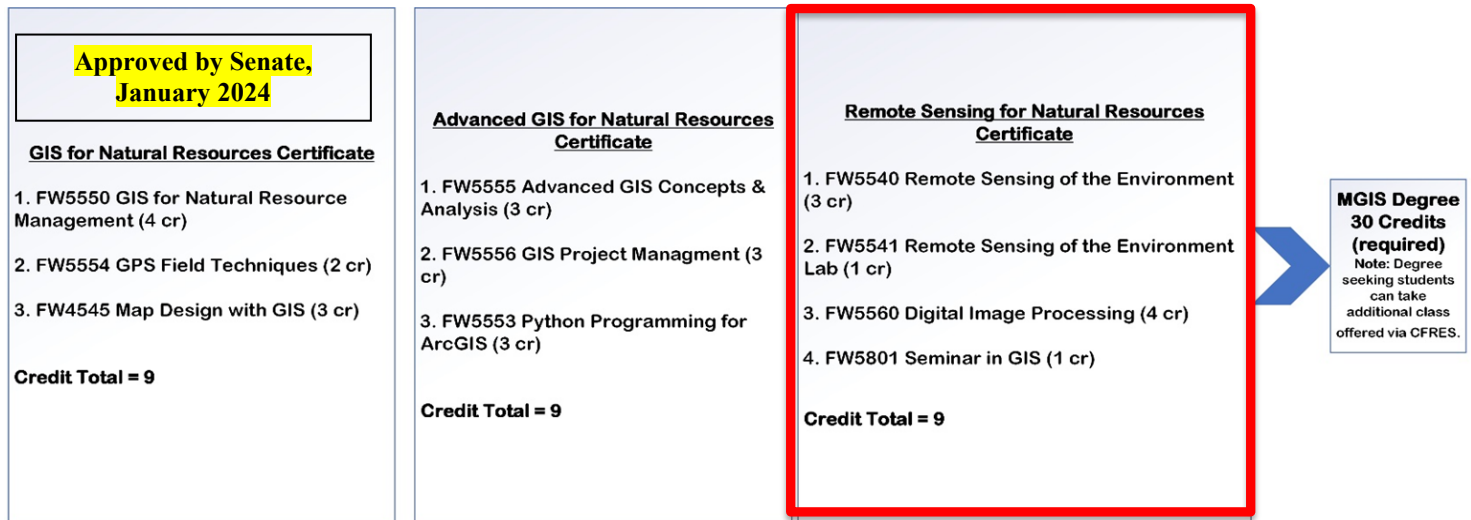| Assessment Points	Graduate Learning Objectives (GLO)
These will include embedded exam questions, a final project culminating, and final grades for FW5540, FW5560, FW5801	GLO1
Lab Assessments and practical exams for FW5541, FW5560, FW5801	GLO2

Fig. 1 How the Remote Sensing for Natural Resources Certificate Fits into Masters of GIS Program. This proposal is shown in the red box, and is the third of three certificates that, if taken in sequence, comprise a Masters of GIS.