Michigan Tech

Office Memo

Office of the Provost and
Senior Vice President for Academic Affairs

Phone: (906) 487-2440
Fax: (906) 487-2935

TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacqueline E Huntoon

DATE: November 18, 2020

SUBJECT: Senate Proposal 11-21

Attached is Senate proposal 11-21, “Establishment of a New Graduate Certificate in Geoinformatics,” and a memo stating the Senate passed this proposal at their November 11, 2020 meeting. I have reviewed this memo and recommend approving this proposal.

I concur X do not concur_____ with this recommendation.

Richard Koubek, President

11/19/20

Date

Michigan Tech

University Senate

DATE:	November 12, 2020
TO:	Richard Koubek, President
FROM:	Sam Sweitz University Senate President
SUBJECT:	Proposal 11-21
COPIES:	Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on November 11, 2020, the University Senate approved Proposal 11-21, "Establishment of a New Graduate Certificate in Geoinformatics". Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University Proposal

Proposal 11-21

Establishment of a New Graduate Certificate in Geoinformatics

Submitted by:
Department of Geological and Mining Engineering and Sciences

1. **Proposal Date:** May 26, 2020

2. **Proposing Contacts and Departments:** Xin Xi, GMES (xinxi@mtu.edu)

3. **Sponsor Department Approvals**: GMES

4. **General Description and Characteristics of Certificate**

4.1. General Description

The Department of Geological and Mining Engineering and Sciences proposes a 9-credit graduate certificate program in Geoinformatics. The certificate will equip students with the knowledge and skills they need to pursue new opportunities created by the increasing demand for geospatial professionals and big data analytics experts. This certificate program explores the principles and applications of geospatial statistics and modeling, predictive analytics, and remote sensing in the geoscience context. The program is complementary to the broad field of data science, and will be offered in a fully online course format.

4.2. Catalog Description

The Certificate in Geoinformatics is designed to develop knowledge and skills in geospatial data analytics and information science, including geospatial statistics, modeling and visualization, predictive analytics, remote sensing applications, and programming development using industry standard tools (ArcGIS, Python, R, etc.). The courses integrate numerous examples from geoscience and social science disciplines to enrich students' experience with real-world problem solving.

5. **Rationale for the Certificate**

This certificate is designed to attract students seeking skill sets in the field of geospatial data analytics and information science. Current students enrolled in the GMES graduate programs can complete the required courses and be awarded the certificate along with the primary degrees. Also, the certificate will provide the academic training for current graduate students enrolled in other programs at Michigan Tech (forestry, civil &

environmental engineering, social sciences, business, etc.), who seek new knowledge and skills to work with geospatial data in their fields.

The certificate is also geared for professionals or recent graduates who are pursuing training opportunities and looking to develop marketable skills. Upon the completion of this certificate, certificate-seeking students can elect to enroll in a full degree program at GMES, provided that they meet the program requirements. The certificate is also available for international students who seek online education or training opportunities in the U.S.

6. Related Programs

A large number of universities in the nation offer fully online graduate certificates related to Geoinformatics with different course structure, required credits, and cost. These certificates are mostly from Geography degree programs with heavy focus on the desktop/web GIS applications and database management. Unlike these programs, our certificate will emphasize on data programming and analytics, and build the skills which are marketable not only for GIS-related jobs, but also for the more lucrative data scientist or engineer opportunities.

Below are a few examples.

University of Southern California. The Geographic Information Science and Technology (GIST) certificate includes 3 required courses in Spatial Thinking, Spatial Databases and Spatial Data Acquisition, and 1 from 9 electives, 16 credits in total. Also includes a weeklong GIS fieldwork. Total cost is $1928 per credit. https://gis.usc.edu/online-programs/certificate-geographic-information-science-and-technology-grad/

Michigan State University. The Professional GIS Certificate program includes 4 required courses in Geospatial Technology, GIS, Remote Sensing, and Cartography. Cost is $775 per course. http://ongeo.msu.edu/certificates/

Penn State University. The GIS certificate is the first year of the Master of GIS degree. It includes 3 required courses and 1 elective course, 12 credits in total. Cost is $912 per credit.
https://www.worldcampus.psu.edu/degrees-and-certificates/geographic-information-systems-gis-certificate/overview

Johns Hopkins University. The GIS certificate includes 5 courses (20 credits) in Web GIS, GIS, Geospatial Statistics, Spatial Analytics, and Programming in GIS. Cost is $4129 per course.
https://advanced.jhu.edu/academics/certificate-programs/geographic-information-systems

Tufts University. Two 12-credit certificates are offered in GIScience and Spatial Data Analytics. Required courses are Intro GIS, Advanced Spatial Modeling, and Spatial Programming in Python.

https://as.tufts.edu/uep/current/certificate-programs

NC State University. GIS certificate includes 12 credits (2 required courses and 2 electives). Cost is $462 ($1311) per credit for residents (nonresidents). https://online-distance.ncsu.edu/program/graduate-certificate-in-geographic-information-science/

University of Arizona. Professional GIS Technology Certificate includes 4 required courses (17 credits). Cost is $820 per credit. https://online.arizona.edu/programs/graduate-certificate/online-graduate-certificate-professional-geographic-information

Finally, a Masters of Geographic Information Science is offered through the College of Forest Resources and Environmental Science at Michigan Tech, and additional graduate certificates focusing on natural resource geospatial sciences are under development as standalone graduate certificates and as stackable certificates towards that degree program. This proposed certificate in Geoinformatics may be used as a stackable certificate within the MGIS program if the classes selected meet the requirements of that program.

7. Projected Enrollment

Initially, the program will have most of its enrollment from current graduate students at GMES or other programs at Michigan Tech. Offering the certificate in a fully online format will expand the number of student enrollment.

Semester	On-campus enrollment	Online enrollment
Fall 2021	5	5
Fall 2022	7	10
Fall 2023	10	15
Fall 2024	15	25

8. Scheduling Plans

The on-campus coursework will be offered during regular instructional time periods and will not require changes to scheduling of classes. Online offerings will be offered at least once every two years.

9. Curriculum Design

This 9-credit certificate consists of one 3-credit required courses and two 3-credit electives. Only three credits may be at the 4000 level. The required and elective course list with the course descriptions are given below.

Required Course (3 credits):

GE 5515 - Advanced Geoinformatics (3 cr., Spring)

Elective Courses (6 credits from below):

GE 5870 Geostatistics and Data Analysis (3 cr., Spring)
FW 5553 Python Programming for ArcMap GIS (3 cr., Fall)
FW 5550 Geographic Information Science and Spatial Analysis (3 cr., Fall), or SS 5049 GIS Applications for the Graduate Researcher (3 cr., Fall)
FW 5555 Advanced GIS Concepts and Analysis (3 cr., Fall), or SS 5050 Advanced GIS Methods and Projects (3 cr., Fall)
SU 5012 Geospatial Data Mining and Crowdsourcing (3 cr., Spring)

10. Course Descriptions

GE 5515 Advanced Geoinformatics (3 cr.)
This course covers topics on GIS analysis methods, including network analysis, cost distance analysis, site selection and optimization, interpolation, multi-layer raster data analysis and more. Basic concepts and techniques associated with the analysis of spatial relationships and patterns are introduced using application examples in geophysical ecological, environmental, epidemiological, and transportation research.

GE 5870 Geostatistics and Data Analysis (3 cr.)
The course introduces concepts of spatial data analysis techniques. The course covers the concept of conditional probability and Bayesian statistics, spatial continuity modeling (variogram, correlogram, spatial covariance), spatial interpolation (ordinary, simple, lognormal kriging, indicator kriging), geostatistical simulations (Sequential Gaussian simulation, Sequential Indicator simulation, LU simulation), multivariate geostatistics (cokriging, Bayesian kriging), multiscale modeling (area-to-point and area-to-area geostatistics), regression and classification modeling, Applications to Geosciences problems including resolution improvement, spatial mapping, inverse technique, predictive modeling are introduced.

FW 5553 Python Programming for ArcMap GIS (3 cr.)
An introduction to Python scripting and basic Python coding within ArcMap. Labs cover tasks found in typical GIS workflows. Students learn how to write and debug Python scripts, models and mapping programs.

FW 5550 Geographic Information Science and Spatial Analysis (3 cr.)
Use of geographic information systems (GIS) in resource management. Studies various components of GIS in detail, as well as costs and benefits. Laboratory exercises use ArcGIS software package to solve resource management problems.

FW 5555 Advanced GIS Concepts and Analysis (3 cr.)
This course moves beyond the fundamentals of GIS to explore the application of GIS technology to environmental monitoring and resource management issues. Students learn graphic modeling techniques, network analysis, 3D visualization, geodatabase construction and management, and multivariate spatial analysis.

SS 5049 GIS Applications for the Graduate Researcher (3 cr.)
Applications of Geographic Information Science and Technologies for research problem identification, analysis, and dissemination. Students learn how to use GIS as a tool to collect and analyze qualitative and quantitative data for graduate research. Hands-on experience in data collection, analysis, and problem solving

SS 5050 Advanced GIS Methods and Projects (3 cr.)
Advanced application of Geographic Information Systems in social sciences as a tool to collect and analyze qualitative and quantitative data. Students gain hands on experience in data collection, advanced spatial analysis, and scripting.

SU 5012 Geospatial Data Mining and Crowdsourcing (3 cr.)
This course introduces data mining of text and pictures from social media, metadata, including natural language processing theory and geospatial applications using crowdsourcing geospatial platforms. Course focuses are: open source spatial data mining (R, GeoKettle); hands-on experience based on real-life application scenarios; proof-of-concept to demonstrate data mining techniques learned and geospatial crowdsourcing.

11. Model Schedule Demonstrating Completion Time

The Certificate can be completed in a two-semester sequence or spread over three semesters (depending on student preference and scheduling requirements). The courses are offered in the semester listed below.

Fall semester:

FW 5553 Python Programming for ArcMap GIS
FW 5550 Geographic Information Science and Spatial Analysis
FW 5555 Advanced GIS Concepts and Analysis
SS 5049 GIS Applications for the Graduate Researcher
SS 5050 Advanced GIS Methods and Projects

Spring semester:

GE 5515 Advanced Geoinformatics
GE 5870 Geostatistics and Data Analysis
SU 5012 Geospatial Data Mining and Crowdsourcing

12. Library and Other Learning Resources

No library or other learning resources are required at this time.

13. Faculty Resumes

The following faculty are assigned to teach the curriculum:

Snehamoy Chatterjee, Associate Professor, Geological and Mining Engineering and Sciences. https://www.mtu.edu/geo/department/faculty/chatterjee/

Don Lafreniere, Associate Professor, Social Sciences
https://www.mtu.edu/social-sciences/department/faculty/lafreniere/

Eugene Levin, Associate Professor, Civil and Environmental Engineering

https://www.mtu.edu/cee/people/faculty-staff/faculty/levin/

Thomas Oommen, Professor, Geological and Mining Engineering and Sciences.
https://www.mtu.edu/geo/department/faculty/oommen/

Rudiger E. Wolf, Research Assistant Professor, Geological and Mining Engineering and Sciences. https://www.mtu.edu/geo/department/faculty/wolf/

Xin Xi, Assistant Professor, Geological and Mining Engineering and Sciences
https://www.mtu.edu/geo/department/faculty/xi-xin/

Ann Maclean, Professor Emerita https://www.mtu.edu/forest/about/faculty-staff/faculty/maclean/

Mickey Jarvi, PhD, Lecturer in Natural Resources
https://www.mtu.edu/forest/about/faculty-staff/faculty/jarvi/

Michael Hyslop, Principal Lecturer https://www.mtu.edu/forest/about/faculty-staff/faculty/hyslop/

Tao Liu, Assistant Professor (profile not yet available, new fall 2020).

14. Equipment

No equipment will be required.

15. Program Cost

Initial costs for offering the certificate to on-campus students will not incur additional costs. The online offering of the certificate may require continued backing of the graduate teaching support as well as agreement between the departments and Graduate school for faculty teaching loads for the online sections. Currently, GE5515 is being offered online (asynchronous). A few other courses (SS5049, SS5050, GE5870) are offered in hybrid mode (face-to-face and asynchronous online).

16. Space

No additional space will be required.

17. Policies, Regulations and Rules

None

18. Accreditation Requirements

None

19. Planned Implementation Date

Spring 2021

20. Assessment

Students achieving the learning objectives for this certificate will be able to

(a) Employ core concepts in geoinformatics, including computational components, data processing and visualization features, and statistical functions in applications of geospatial science in earth resource and environmental science settings.
(b) Properly use commercial tools (e.g., ESRI ArcGIS, Python) and/or equivalent user-developed tools in applications of appropriate large-scale data analysis and visualization to earth resource and environmental science related problems.
(c) Effectively communicate the results of data processing and the interpretations of the resulting products.