The University Senate of Michigan Technological University

Proposal 18-13

(Voting Units: Academic)

"Proposal for a Master of Geographic Information Science (MGIS)"

Submitted by the School of Forest Resources and Environmental Science

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1) Description and characteristics of program

The Master of Geographic Information Science (MGIS) degree, a professional master's program (Senate 18-11), will initially be administered in the School of Forest Resources and Environmental Science (SFRES). This program builds upon the School's existing Master of Forestry degree and the expertise within the School in spatial information science. Over time, the program may become non-departmental as it grows and involves students from a broad range of academic backgrounds.

This professional program will provide current and cutting-edge education in Geographic Information Science and related technologies, and train students to work as GIS specialists and managers. A strong foundation in core geospatial principles will be provided, as well as interdisciplinary study in statistics, communications, environmental policy, and business.

The degree is designed as a 30 credit coursework-only degree and will also be offered as an accelerated Master's program to Michigan Technological University students (Senate 13-11). As interest in 4+1 programs continues to develop, this program will provide the opportunity for our students to complete both a bachelor's and master's degree in 5 years. The scheduling will allow completion of the degree in three semesters (two semesters for students who have attended Michigan Tech and have certain prerequisites).

2) Rationale

Professional Master's degrees are consistent with the goals of Michigan Tech's strategic plan[1]

Goal 2: 2.1, second bullet: strengthen existing programs and develop new offerings in emerging interdisciplinary areas.

Goal 3: 3.1, third bullet: increase residential and non-residential master's offerings and enrollment

Geospatial jobs are in high demand, have exhibited continued growth even during the recent recession[2] and were recently listed among the 100 best careers in the United States.[3] Geospatial training has been targeted by the U.S. Department of Labor for a high growth job training initiative, as it is a field that is expanding at a rate of 10% annually with a projected shortfall of skilled workers[4] · Those with geospatial skills are included in a recent McKinsey Global Institute report on workers with "big data" expertise. Both analysts and managers are identified, with a potential deficit of 190,000 workers by 2018.[5]

Uses of geospatial technology are broad and cross many disciplines, including demographics, natural resources, urban and regional planning, public health and epidemiology, law enforcement, and homeland security.[6] The classification of geospatial jobs has been inconsistent because GIS has many applications and is utilized in multiple fields. GIS positions are often associated and combined with Information Technology because GIS deals so intimately with computers and data. Though IT experience is useful for GIS users, a wide range of skills in addition to computer literacy are required to be a successful geospatial professional. To address these shortcomings, and with prompting from both industry and the education sector, the U.S. Department of Labor has recently developed the Geospatial Technology Competency Model.[7] The model document outlines the knowledge and skills necessary to perform as an effective GIS professional, and was used as a guide in developing this proposal.

3) Discussion of related programs within Michigan Tech and at other universities

The most closely related program at Michigan Tech is the Master of Science in Integrated Geospatial Technology, housed in the School of Technology (program information is available at http://www.mtu.edu/technology/graduate/igt/study/). The School of Technology's IGT M.S. is primarily a research-oriented degree with a focus on geospatial data acquisition and processing. In contrast, the professional Master of GIS is designed as a terminal degree for students not planning to earn a PhD or perform research. Rather, it is designed to give students the skills to work as GIS specialists or managers. The School of Technology's Integrated Geospatial Technology degree does offer a Plan C Masters as an option; however, it has different requirements for admission and will likely attract students with a surveying or engineering degree. The Master of GIS is designed for people with limited or no background in GIS and associated tools. Furthermore, the IGT M.S. has a significant distance learning component, whereas the Master of GIS will initially be offered primarily on-Campus with traditional lectures and supervised lab sessions.

Non-research Master's in GIS are offered at a number of universities in the U.S., either on-Campus (e.g., Michigan State), online only (Penn State), or a mixture of online and on-Campus (UMD).[8] A professional Master of GIS at Michigan Tech will be successful because 1) many of the students enrolled in the program will be Michigan Tech graduates pursuing the accelerated Master's degree option and 2) no similar program is offered locally.

Presently, undergraduates at Michigan Tech in the School of Forest Resources and Environmental Science and students in the Surveying Engineering program in the School of Technology have a required geospatial component in their degree programs. GIS is taken as an elective in a number of other disciplines. For example, biology, computer science, environmental engineering, geology, and social science students frequently enroll in existing GIS courses.

Though the use of spatial tools is necessary to be a successful student in upper division SFRES classes, only one GIS and one GPS course are required for graduation – a total of five credits. These courses are enough to grasp introductory theory and learn the basics of a tool, but not enough to develop the broad and deep understanding of spatial theory and the applications necessary to work as a geospatial professional.

4) Projected enrollment

We project an annual enrollment of at least 10-15 students in this program. While some students will be drawn from other areas of the U.S. or from professionals in the region, most students will likely be recent undergraduates from Michigan Tech. The majority of Michigan Tech graduates coming into the program will likely have degrees from the School of Forest Resources and Environmental Science, or from other majors such as Environmental Engineering, Biological Sciences, Geology, or Social Science. Students with a background in any of these disciplines would also be a good fit with the MGIS degree.

We anticipate enrollment will be more or less continuous. Because this program will draw students that are largely self-funded, enrollment should be independent of general trends at the University. Enrollment in the Master of Forestry program has averaged 5 students annually over the last 5 years. Current enrollment in SFRES is 271 (186 undergraduate and 85 graduate students).

5) Scheduling plans

Courses will be taught during regular daytime hours or in the evening. Over time, some of the courses will be adapted for web-based delivery, and perhaps as summer courses.

6) Curriculum Design

Students admitted to this program will have a B.S. in any discipline (including students admitted to the accelerated program). The MGIS is designed to be completed in three semesters for students entering the program without prerequisites, but can be completed in two if six credits are counted from a Michigan Tech undergraduate degree under the accelerated Master's option. Once admitted, students must complete a minimum of thirty credits of coursework past their undergraduate degree. It is a Plan C

(coursework only with required oral examination) Masters with no thesis or report options. Students will choose a faculty advisor from within the program.

General Curriculum Design

Introductory GIS	4 credits
Advanced GIS concepts	3 credits
Implementing and managing GIS projects	3 credits
GPS field techniques	2 credits
Remote sensing	3-4 credits
Communications	2 credits
Spatial Statistics	3 credits
Electives	9-10 credits
Total	**30 credits**

The following courses are required (new courses are in **BOLD** and include the name or position of the instructor):

Introductory GIS

FW5550 - GIS for Resource Management (4 credits, Fall)

Advanced Spatial Topics (GIS, GPS, cartography, data and project management)

FW5554 – **GPS field techniques** (2 credits, Fall) (Professor of Practice)

FW5555 - **Advanced GIS Concepts and Analysis** (3 credits, Spring) (Maclean) Pre-requisite: FW5550

FW5556 – **GIS Project Management** (3 credits, Spring) (Professor of Practice) Pre-requisite: FW5550

Spatial Statistics

FW5510 – Special Topics in Natural Resources - Spatial Statistics (3 credits, Spring) (Falkowski and Professor of Practice (alternate years)). This special topics class will be renumbered as a regular class.

Remote Sensing

FW4540 - Remote Sensing of the Environment (3 credits - alternate Fall semesters) or

FW5540 - Advanced Terrestrial Remote Sensing (4 credits, alternate Fall semesters) or

FW5560 - Digital Image Processing: A Remote Sensing Perspective (3 credits, Spring) Pre-requisite: FW5550 or

GE4250 - Fundamentals of Remote Sensing (3 credits, Spring) Pre-requisites: PH2200 and MA2160 or

SU4140 - Photogrammetry (3 credits, Fall) Pre-requisite: SU2260

Communications

FW5801 – Masters Seminar in GIS (1 credit, Fall and Spring) (Professor of Practice)

Electives (select 10-11 credits from the following lists)

Business

BA5650 - Project Management (3 credits, Fall, Spring, Summer) Pre-requisite: MA2710 or MA 2720 or MA 3710

BA5760 - Corporate Social Responsibility & Business Ethics (3 credits, on demand)

Cartography

SS5XXX Critical Cartography (1 credit, Summer)

Computer Science

CS4421 - Database Systems (3 credits, Spring) Pre-requisite: CS2321

Communications and writing

FW5850 - Effective Grantsmanship Workshop (2 credits, Spring)

HU5081 - Writing Applications in Technical Communication (3 credits, on demand) NOT in the current course list

HU5091 - Writing for publication (3 credits, on demand)

Geospatial applications

UN4000 - Remote Sensing Seminar (1 credit, Fall & Spring)

FW3540 - Introduction to GIS for Natural Resource Management (4 credits, Spring) Pre-requisite: MA 2710 (C) or MA 2720 (C) or MA 3710 (C)

FW4545 - Map Design with GIS (3 credits, alternate Spring) Pre-requisite: FW3540 or FW5550

SU3540 - Geospatial Information Technology (4 credits, Spring) Pre-requisite: MA3710

SU5003 - GIS Fundamentals (1 credit, on demand)

SU5004 - Introduction to Geospatial Image Processing (3 credits, on demand)

SU5041 - Geospatial Data Processing (3 credits, on demand)

Policy

ENG5520 - Sustainable Futures II (3 credits, Spring)

FW5111 - Advanced Natural Resource Policy (3 credits, Fall)

FW5150 - Institutions and Natural Resource Management (up to 3 credits, Fall, Spring, Summer)

Natural resources

CE5666 - Water Resources Planning and Management (3 credits, on demand) Pre-requisites CE3620 and (EC3400 or EC3402 or ENT3402)

ENVE4505 - Surface Water Quality Engineering (3 credits, Fall) Pre-requisite: ENVE3501 or ENVE 3503

FW 4220 - Wetlands (4 credits, Fall)

FW4300 - Introduction to Wildland Fire (3 credits, Spring) Pre-requisite: FW3020 and (FW3010 or FW3012)

FW4370 - Forest and Landscape Hydrology (3 credits, Spring)

FW4380 - Landscape Ecology (3 credits, Spring)

FW5032 - Integrated Forest Inventory and Data Analysis (3 credits, Spring)

FW5088 - Forest Finance & Economics (3 credits, Spring)

FW5130 - Forest Vegetation Dynamics (3 credits, Fall) Pre-requisites: BL3400 or FW3010 or FW3012 or FW3020

FW5140 - Stable Isotopes in Ecology and Environmental Science (2 credits, Fall)

FW5413 - Sustainable Biomass (3 credits, Fall)

GE4150 - Natural Hazards (3 credits, Fall) Pre-requisites: (GE2000 or GE2100) and UN2002

Statistics

EC4200 - Econometrics (3 credits) Pre-requisites: (EC2001 or EC3002 or EC3003) and (BA2100 or BUS2100 or MA2710 or MA2720 or MA3710) and (MA1135 or MA1160 or MA1161)

FW5411 - Applied Regression Analysis (3 cr, alternate Spring semesters)

MA4710 - Regression Analysis (3 cr, Spring) Pre-requisites: MA2720 or MA3710

MA4740 - Sampling Methods (3 cr, on demand)

MA5701 - Statistical Methods (3 cr, Fall)

Example MGIS course sequence for a Michigan Tech BS degree holder

As an undergraduate, take FW3540 - Intro to GIS for Resource Management (4 credits) and FW5111 - Advanced Natural Resource Policy (3 credits). Six of these credits may be applied.

Fall

FW5550 - GIS for Resource Management (required)	(4 credits)
FW5554 - GPS Field Techniques (required)	(2 credits)
FW5801 - Masters Seminar in GIS (required)	(1 credit)
EC4300 - Econometrics	(3 credits)
GE4150 - Natural Hazards	(3 credits)
Total	*13 credits*

Spring

FW5555 - Advanced GIS Concepts and Analysis (required)	(3 credits)
FW5560 - Digital Image Processing (required from list)	(3 credits)
FW5556 – GIS Project Management (required)	(3 credits)
FW5510 – Special Topics in Natural Resources - Spatial Statistics (required)	(3 credits)
FW5801 - Masters Seminar in GIS	(1 credit)
Total	*13 credits*

Accelerated Master's credits	6 credits
Fall semester	13 credits
Spring semester	13 credits
Total	***32 credits***

Example MGIS course sequence for an external student

Spring

SU3540 - Geospatial Info Technology	(4 credits)
FW5510 - Spatial Statistics (required)	(3 credits)
GE4250 - Fundamentals of Remote Sensing	(3 credits)
FW5801 - Masters Seminar in GIS (required)	(1 credit)
Total	*11 credits*

Fall

FW5550 - GIS for Resource Management (required)	(4 credits)
FW5540 – Adv.Terrestrial Remote Sensing (required from list)	(4 credits)
FW5554 - GPS Field Techniques (required)	(2 credits)
GE4150 - Natural Hazards	(3 credits)
Total	*13 credits*

Spring

FW5555 - Advanced GIS Concepts and Analysis (required)	(3 credits)
FW5556 – GIS Project Management (required)	(3 credits)
FW5850 - Effective Grantsmanship	(2 credits)
FW5801 - Masters Seminar in GIS	(1 credit)
Total	*9 credits*

Spring semester	11 credits
Fall semester	13 credits
Spring semester	9 credits
Total	***33 credits***

7) New Course descriptions

FW5554 – GPS Field techniques. 2 credits, offered in Fall. This course will provide hands-on experience with various types of GPS units and different applications of the technology, including planning, data collection, data processing, and management. Emphasis will be on practical applications of global positioning system technology.

FW5555 – Advanced GIS Concepts and Analysis. 3 credits, offered in Spring. Enrollment priority will be given to students in the professional MS in GIS degree program, but will be open to students in other programs. This course moves beyond the fundamentals of GIS to explore the application of GIS technology to environmental problems. Students review current research in the field, learn relevant modeling techniques, and utilize advanced GIS software tools such as network analysis, 3D visualization, geodatabase management and rule construction, and multivariate spatial analysis. Prerequisite: FW5550 or permission of instructor.

FW5556 – GIS Project Management. 3 credits, offered in Spring. Enrollment priority will be given to students in the professional MS in GIS degree program, but will be open to students in other programs. This course will provide exposure to geospatial data collection using GPS (both consumer– and resource–grade GPS), database structures and data management strategies, spatial project planning and management, and cartographic techniques, and will include discussion of geospatial ethics. Development of a project database and geospatial portfolio is required. Prerequisite: FW5550 or permission of instructor.

FW5801 – Masters Seminar in GIS. 1 credit, offered in Fall and Spring. This course is designed for students in the professional MS in GIS degree program, but will be open to students in other programs. Students will discuss and present current research and applications of geospatial technology.

SS5XXX Critical Cartography. 1 credit, offered in Summer. This course will examine: available datasets for human variables; and the interpretation of maps based on scale, boundaries, projection system, and other information that affect messages regarding power and influence, and assumed relative importance of environmental, social and economic issues.

The other classes listed without full class numbers are currently in the binder process or are offerings under existing programs.

8) Library and other learning resources

No additional library resources are requested. Interlibrary loan and existing journals are adequate, especially as this is a professional, non-research program.

9) Computing access fee

No computer access fees per centralized IT. Additional course fees may apply.

10) Faculty Résumés

Yushin Ahn, School of Technology http://www.mtu.edu/technology/school/faculty/ahn/

Michael Falkowski, School of Forest Resources and Environmental Science
http://www.mtu.edu/forest/about/faculty/falkowski/

Michael Hyslop, School of Forest Resources and Environmental Science
http://www.mtu.edu/forest/about/faculty/hyslop/

Eugene Levin, School of Technology http://www.mtu.edu/technology/school/faculty/levin/

Ann Maclean, School of Forest Resources and Environmental Science
http://www.mtu.edu/forest/about/faculty/maclean/

11) Description of available / needed equipment

Existing teaching laboratory computers and GPS equipment in SFRES will be utilized. We currently maintain a 26-seat main computer lab, a 16-seat spatial teaching lab, and a 6-seat graduate computing lab. These facilities will be adequate to add the necessary one lab section per semester. Michigan Tech has maintained an annual site license for ESRI products (chiefly ArcGIS software) since 1997. ArcGIS is the most widely-used GIS software and will be the primary GIS application used in labs. SFRES also maintains a number of consumer- and mapping-grade GPS units for teaching and research, which will be available for use by students enrolled in the program.

12) Program costs, years 1 through 3

Three-year costs will be $201,000, with projected tuition revenue of $509,960 during the same period. Each year thereafter we project a surplus of tuition revenue over costs of between $100,000 and $180,000 per year. The major expense to the University will be support for a Professor of Practice who will serve as both coordinator of the program and as an instructor. While there are clearly additional costs in offering an additional program, the surplus of tuition revenue over costs is clearly more than sufficient to cover those costs. The Professor of Practice will manage the program, recruit and help advise graduate students, and teach courses (FW5554 3 credits, FW5556 3 credits, and FW5801 1 credit twice (total 7 credits each year) annually and FW3540 and FW5510 every other year average 4 credits per year)). This represents approximately 60% of a full teaching load. The Professor of Practice is budgeted at 80% of an academic year (9-month) position to include 20% time coordinating the program (including recruiting, advising and developing the program). No additional faculty needs are anticipated.

Based on the projected enrollment of 10 students per year at 10 credits per semester, tuition revenue would total $149,000 annually – see table below. Tuition is as posted on the sponsored programs website, with costs for the coordinator averaging $67,000 (salary and fringe) for years 1–3. Based on the graduate tuition rate and 20 credits per student per year, 4.5 students enrolled annually would support this program as proposed.

	2013-14	**2014-15**	**2015-2016**
Professor of Practice (salary and fringe)	**$65,000**	**$67,000**	**$69,000**
Number of graduate students	**6**	**10**	**14**
Tuition per credit	**$789**	**$836**	**$886**
Tuition revenue based on 20 credits per student per year	**$94,680**	**$167,200**	**$248,080**
Income developed from program	**$29,680**	**$100,200**	**$179,080**

Note that in reality income is greater than shown in the table as students complete the remaining required credits either in a third semester (an additional 10 credits per student), or during their undergraduate degree through senior rule (an additional 4 credits per student).

13) Space

No additional space will be necessary. Based on projected enrollment, the existing teaching lab, open computer labs on campus, and graduate offices in SFRES will provide adequate space for the program.

14) Policies, regulations, and rules

No new policies or rules will be needed. All existing graduate school policies will be adhered to.

Applicants must meet all requirements for admission by the Graduate School and the School of Forest Resources and Environmental Science at the time of application, and must follow specified admission procedures. For international applicants, this includes submission of TOEFL scores. Applications will be considered using the existing process in SFRES, which includes faculty review of applications. In addition, the program coordinator will review applications. A combination of academic background, professional knowledge, the applicant's statement of purpose, letters of recommendation, and test scores required by the graduate school, will be considered before making a decision to admit a student.

15) Accreditation requirements

None. The program is, however, designed to provide training and skills identified in the Geospatial Technology Competency Model.[9]

We anticipate that ultimately this program will be listed as a Professional Science Master's program with an associated advisory board of professionals in the field, and that this designation will be used when promoting the program.

16) Internal status of proposal

In development, internal to SFRES, September 2012

Submitted for comment to all units with classes listed – revised November 2012

17) Planned implementation date

Fall semester of 2013

References

1 https://www.banweb.mtu.edu/pls/owa/strategic_plan2.p_display

2 http://www.geospatialtoday.com/gst/index.php?option=com_content&view=article&id=216

3 http://money.cnn.com/magazines/moneymag/bestjobs/2010/qualitylife/index.html

4 http://www.doleta.gov/brg/pdf/Geospatial%20Final%20Report_08212007.pdf

5 http://www.mckinsey.com/Insights/MGI/Research/Technology_and_Innovation/Big_data_The_next_frontier_for_innovation, page 30

6 http://americancityandcounty.com/technology/gis_gps/report_shows_trends_gis/

7, 9 http://www.careeronestop.org/competencymodel/pyramid.aspx?geo=Y

8 http://www.geo.msu.edu/acad_prog/msgiscireq.html or http://www.worldcampus.psu.edu/MasterinGIS.shtml and http://www.geog.umd.edu/gis/

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