

## Program Approval

### I. General Information

#### A. Institution

Kansas State University

#### B. Program Identification

Degree Level:	Bachelor's Program
Program Title:	Geographic Information Science and Technology (GIS&T)
Degree to be Offered:	Bachelor of Science in Geographic Information Science and Technology (GIS&T)
Responsible Department or Unit:	Department of Geography and Geospatial Sciences
CIP Code:	45.0702
Modality:	Hybrid
Proposed Implementation Date:	Fall 2020

Total Number of Semester Credit Hours for the Degree: 120

### II. Justification

Geographic Information Science (GIScience) is the academic discipline that underpins the wise use of geospatial technologies and methods, including geographic information systems (GIS), acquisition and analysis of remotely sensed imagery, cartography and mapping, and quantitative spatial analysis and modeling. Collectively, this knowledge and skills area is referred to as Geographic Information Science and Technology (GIS&T).

Graduates with expertise in GIS&T enjoy excellent employment prospects in a variety of career fields well beyond that suggested by the CIP code 45.0702 (cartographers and photogrammetrists) used to characterize this proposal. Other common job titles include GIS analyst and GIS technician. Associated duties include analyzing spatial data using mapping and statistical software, designing digital maps with geographic data and other non-spatial datasets, designing and maintaining relational databases, writing programs and scripts to improve and expedite analyses, and developing custom software applications to deliver web-based geographic services to end users. These tasks require technical skills, critical thinking, and creativity.

Undergraduate degree programs at many universities in fields such as geography – the traditional academic home of GIScience – have long addressed this need. However, GIS&T is (1) a domain that experiences rapid change due to technological developments, (2) a subject area often conflated by employers with computer science and data analytics/statistics skillsets, and (3) a career field that is highly dispersed across many job sectors within the global work force. It is, by its very nature, an interdisciplinary field of study and career path.

This proposed interdisciplinary program delivers focused content in the specific areas of geographic, or spatial, data management, analysis, and application development that is in high demand within the public and private sectors. It also affords students the opportunity to specialize in a variety of application areas through electives to customize their educational experience. This design provides students with the ability to earn additional academic credentials (e.g., double-majors, minors, certificates) at little to no cost that are in line with their interests and career objectives, whether that is immediate workforce entry or further graduate-level education.

Specifically, this program will prepare students to:

- Develop technical competencies in analysis/modeling, programming, and cartography/visualization.

- Apply technical skills critically to solve spatial problems.
- Enhance the effectiveness of technical skills by developing expertise in cognate fields of study (e.g., areas of specialization through electives).
- Provide a strong STEM undergraduate degree experience that increases the competitiveness of graduates for private and public sector employment or admittance to graduate school for further study in GIS&T or cognate fields.
- Prepare students for future professional GIS&T certification through third parties such as the GIS Certification Institute for continued job advancement.
- Function effectively as both a member and leader of a team engaged in the analysis or visualization of geospatial data.

Employment projections from market research firms and government agencies point toward considerable growth in the geospatial technology industry (Prescient & Strategic Intelligence 2019) and growth in GIS-related employment sectors and fields (Bureau of Labor Statistics 2020, U.S. Department of Labor 2020). Such jobs exist in private companies and government agencies focused on consumer navigation technology, engineering consulting, environment and natural resources, disaster management, land surveying, transportation, geospatial intelligence, agriculture and biosecurity, socioeconomic analysis, business planning, public health and healthcare, and urban planning and design. GIS&T employer expectations across these varied sectors continue to evolve with prerequisite knowledge and skill sets that span traditional academic discipline boundaries that can best be met – both now and into the future – with an interdisciplinary degree program (Hong 2016).

### III. Program Demand: Market Analysis

We conducted a market analysis and found strong potential for a new GIS&T program in Kansas to succeed. Key findings included:

- **Multiple indicators suggest growing student demand for bachelor’s degree programs in GIS&T.** Despite rising tuition costs and fewer credit hours required for graduation, the Undergraduate GIS Certificate at Kansas State University (established 2004) enjoys strong participation and completion rates. Between 2006 and 2019, 110 undergraduates from 11 majors and four colleges have chosen to pursue, and earn, this additional credential. In an internal survey conducted in 2018 of students, alumni, and faculty from the Department of Geography and Geospatial Sciences, over 80% (n = 30) strongly supported the development of a new GIS&T major to strengthen our reputation of excellence in this area and to make our students even more competitive for expanding employment opportunities. Finally, the College Board is currently considering an Advanced Placement GIS&T course which illustrates the diffusion of interest in this career field to the high school level.
- **Future GIS&T graduates have promising job prospects over the next decade at the national, regional, and state levels.** Driven by continued dramatic growth in the global GIS market (Prescient & Strategic Intelligence 2019), occupational projections made by the U.S. Bureau of Labor Statistics through 2028 forecast 15% job growth for cartographers and photogrammetrists compared to the average growth rate of 5% for all occupations (Bureau of Labor Statistics 2020a). GIS&T is also highly dispersed across many job titles and fields, most of which (e.g., geosciences) are expected to see continued job growth into the future (Bureau of Labor Statistics 2020b) or, as with the career “geographer”, comprise necessary skills for highly-ranked science jobs (U.S. News and World Report 2019).
- **Regional competitive saturation for bachelor’s programs in GIS&T is low.** Our internal research revealed that only six of the 22 public R1 universities (doctoral – very high research activity) within a 500-mile radius of Kansas State University offer a separate bachelor’s program with a focus related to this proposal. Most of these programs are in Oklahoma, Texas, and Illinois. However, few are interdisciplinary or feature a balanced curriculum with equal parts computer science and geography/geographic techniques. No separate GIS&T bachelor’s degree program is currently offered by any university or college in the state

of Kansas (Kansas Board of Regents 2019).

- **An opportunity to earn national recognition and position students for professional certification.** This proposed GIS&T degree program is designed to facilitate future accreditation by the U.S. Geospatial Intelligence Foundation (USGIF). If successful, Kansas State University would become the 15<sup>th</sup> non-military academy in the United States to earn such recognition and only the third located west of the Mississippi River (USGIF 2020). Given the mission of the USGIF, program accreditation will enhance the already strong relationship enjoyed between the university and the Department of Defense and increase our stature as a partner with, and educational resource for, the geospatial intelligence community, as well as students interested in national defense careers.

#### IV. Projected Enrollment for the Initial Three Years of the Program

Year	Headcount Per Year		Sem Credit Hrs Per Year	
	Full- Time	Part- Time	Full- Time	Part- Time
Implementation	10	---	280	---
Year 2	15	---	720	---
Year 3	20	---	1,320	---

#### V. Employment

Many employment projections from government agencies and market research firms point toward considerable growth of the geospatial technology industry as well as growth in GIS-related employment sectors and fields. According to the U.S. Department of Labor's Bureau of Labor Statistics (BLS) (2020a), jobs in the fields of cartography and photogrammetry are expected to grow by 15% between 2018 and 2028, with a total estimated growth of 1,700 jobs (11,800 to 13,500) over this same period. The BLS additionally estimates that cartography and photogrammetry will be one of the twenty fastest growing occupations in the United States between 2014 and 2024. In Kansas, the projected growth rate between 2016 and 2026 is 24% (Department of Labor 2020). With a median salary of \$64,500 and only a four-year college degree expected for entry-level employment, employment in jobs related to cartography and photogrammetry are excellent opportunities for recent university graduates who have GIS&T training (BLS 2020a).

#### VI. Admission and Curriculum

##### A. Admission Criteria

Normal Kansas State University admissions criteria for incoming freshmen, transfer, and international students will apply for this proposed program. No additional special criteria are included.

##### B. Curriculum

###### Year 1: Fall

SCH = Semester Credit Hours

Course #	Course Name	SCH 13
CC 110	Introduction to Computer Programming	3
ENGL 100	Expository Writing I	3
GEOG 121	Earth Systems Science	3
GEOG 122	Earth Systems Science Laboratory	1
College Requirement	Social Sciences (not GEOG)	3

**Year 1: Spring**

Course #	Course Name	SCH 15
CC 210	Fundamental Computer Programming Concepts	4
COMM 105	Public Speaking IA	2
GEOG 100	World Geography & Globalization	3
STAT 325	Introduction to Statistics	3
College Requirement	Social Sciences (not GEOG)	3

**Year 2: Fall**

Course #	Course Name	SCH 14
BIOL 198	Principles of Biology	4
GEOG 302	Cartography & Thematic Mapping	3
MATH 205	General Calculus and Linear Algebra	3
PHYS 101	The Physical World	3
PHYS 103	The Physical World Laboratory	1

**Year 2: Spring**

Course #	Course Name	SCH 16
CMST 135	Web Fundamentals	3
CC 310	Data Structures & Algorithms 1	3
ENGL 200	Expository Writing II	3
GEOG 508	Geographic Information Systems I	4
MATH 312	Finite Applications of Mathematics	3

**Year 3: Fall**

Course #	Course Name	SCH 15
CC 315	Data Structures & Algorithms 2	3
GEOG 602	Computer Mapping & Geographic Visualization	3
GEOG 605	Remote Sensing of the Environment	3
GEOG 608	Geographic Information Systems II	3
College Requirement	Humanities: Literary/Rhetorical Arts	3

**Year 3: Spring**

Course #	Course Name	SCH 16
CC 410	Advanced Programming	4
GEOG 705 OR	Thematic Remote Sensing	3
GEOG 706 OR	Biophysical Remote Sensing	3
GEOG 707	Remote Sensing of Water	3
PHILO 386	Philosophy of Computer Science and Engineering	3
Elective	Specialization or Free Elective	3
College Requirement	Humanities: Fine Arts	3

**Year 4: Fall**

Course #	Course Name	SCH 16
CC 560	Database Essentials	3
GEOG 728	Programming for Geographic Analysis	3
GEOG 497 OR	Undergraduate Research in Geography	1
GEOG 610	Geography Internship	1
Elective	Specialization or Free Elective	3

Elective	Specialization or Free Elective	3
College Requirement	Humanities: Western Heritage	3

**Year 4: Spring**

Course #	Course Name	SCH 15
GEOG 495	Capstone Seminar in Geography	3
GEOG 712	Internet GIS and Distributed Geographic Information Services	3
Elective	Specialization or Free Elective	3
Elective	Specialization or Free Elective	3
College Requirement	U.S. Multicultural Overlay	3

**Total Number of Semester Credit Hours.....120**

Completion of the curriculum above will result in students earning a **BS in GIS&T, minor in Geography, and a Computer Science Certificate**. Students must take a minimum of 15 SCH in electives to complete the 120 SCH program of study. Focused collections of electives, or specialization areas, have been designed to help students build an area of practical expertise in the application of GIS&T (e.g., bioinformatics, water resources, public health). Many of these specializations enable students to earn **additional academic credentials at little to no extra cost**. New specializations can be developed as student interest and/or employment trends dictate or in conjunction with extramurally funded projects having specific workforce development goals.

**VII. Core Faculty**

FTE: 1.0 FTE = Full-Time Equivalency Devoted to Program

Faculty Name	Rank	Highest Degree	Tenure Track Y/N	Academic Area of Specialization	FTE to Proposed Program
*Hutchinson, Shawn	Professor	PhD	Y	Geographic Information Science	0.05
Wang, Jida	Asst. Professor	PhD	Y	Remote Sensing	0.1
Goodin, Douglas	Professor	PhD	Y	Remote Sensing	0.05
Nelson, Katherine	Asst. Professor	PhD	Y	Geographic Information Science	0.1
Feldhausen, Russell	Instructor	MS	N	Computer Science	0.1
Maiorana, Francesco	Instructor	MS	N	Computer Science	0.1
Temme, Arnaud	Assoc. Professor	PhD	Y	Geographic Information Science	0.05
Oetken, Michael	Teaching Asst. Professor	MS	Y	Computer Science	0.0625

\* Denotes Program Administrator

**Number of graduate assistants assigned to this program.....4 (beginning YR 3)**

Core faculty FTE's were calculated based on courses that will be taught during the first three years using the following assumptions. For faculty teaching on-campus courses, each class represents 0.1 FTE, with a full teaching load of four courses per year representing 40% of the faculty member's official duties. For faculty facilitating online courses, one class is 0.0625 FTE with eight courses per year comprising 50% of official duties. Since all core faculty listed in this proposal will be teaching classes that already exist, and would exist to serve

other programs without the GIS&T undergraduate major, FTE values are halved (0.05 and 0.03125 per class for on-campus and online courses, respectively) to account for existing but shared faculty time in the classroom.

Funding is provided in the budget (Section VIII) to hire two and four new graduate teaching assistants in Year 2 and Year 3, respectively, to support faculty in courses with increased enrollment generated by this new program.

### VIII. Expenditure and Funding Sources

<b>A. EXPENDITURES</b>	First FY	Second FY	Third FY
<b>Personnel – Reassigned or Existing Positions</b>			
Faculty	\$3,523	\$19,300	\$47,889
Administrators ( <i>other than instruction time</i> )	\$10,500	\$10,605	\$10,711
Graduate Assistants (0 FY1, 2 FY2, 4 FY3)		\$39,000	\$78,780
Support Staff for Administration ( <i>e.g., secretarial</i> )	\$5,000	\$5,050	\$5,101
Fringe Benefits ( <i>total for all groups</i> )	\$6,597	\$15,053	\$27,552
Other Personnel Costs			
<b>Total Existing Personnel Costs – Reassigned or Existing</b>	\$25,620	\$89,008	\$170,033
<b>Personnel – – New Positions</b>			
Faculty			
Administrators ( <i>other than instruction time</i> )			
Graduate Assistants			
Support Staff for Administration ( <i>e.g., secretarial</i> )			
Fringe Benefits ( <i>total for all groups</i> )			
Other Personnel Costs			
<b>Total Existing Personnel Costs – New Positions</b>	\$0	\$0	\$0
<b>Start-up Costs - - One-Time Expenses</b>			
Library/Learning Resources			
Equipment/Technology	\$22,500	\$3,000	
Physical Facilities: Construction or Renovation	\$18,000		
Other – USGIF Accreditation		\$6,000	
<b>Total Start-up Costs</b>	\$40,500	\$9,000	\$0
<b>Operating Costs – Recurring Expenses</b>			
Supplies/Expenses	\$2,520	\$6,660	\$12,240
Library/Learning Resources (Software Site License)	\$6,250	\$6,250	\$6,250
Equipment/Technology		\$25,000	\$25,000
Travel			
Other – USGIF Accreditation Maintenance			\$4,000
Other – UCGIS Membership	\$2,500	\$2,500	\$2,500
<b>Total Operating Costs</b>	\$11,270	\$40,410	\$49,990

<b>GRAND TOTAL COSTS</b>	<b>\$77,390</b>	<b>\$138,418</b>	<b>\$220,023</b>
<b>B. FUNDING SOURCES</b> <i>(projected as appropriate)</i>	First FY	Second FY	Third FY
Tuition (on campus and online)	\$96,173	\$245,444	\$449,670
Student Fees (university, college)	\$24,626	\$50,599	\$94,988
<b>GRAND TOTAL FUNDING</b>	<b>\$120,799</b>	<b>\$296,043</b>	<b>\$544,658</b>
<b>C. Projected Surplus/Deficit (+/-) (Grand Total Funding <i>minus</i> Grant Total Costs)</b>	<b>\$43,409</b>	<b>\$157,625</b>	<b>\$324,635</b>

## IX. Expenditures and Funding Sources Explanations

### A. Expenditures

#### Personnel – Reassigned or Existing Positions

All core faculty are currently employed by Kansas State University in the College of Arts & Sciences, College of Engineering, or K-State Polytechnic and already teach the listed courses as part of their current appointments. No new faculty or instructor hires are required to initiate or maintain the new program.

The percent time dedicated to this program varies by faculty member and the number of courses taught each year as explained in Section VII (Core Faculty) of this proposal. Faculty salary amounts come from the published Kansas State University FY 2019 Annual Budget (Kansas State University 2018) and are included here in the fiscal years when future students begin taking courses as prescribed by the curriculum guide in Section VI.B. Dr. Shawn Hutchinson will assist the department head in administering the program within the Department of Geography and Geospatial Sciences. This effort is reflected in the Administrators line of the budget with one summer month of pay each year.

New graduate teaching assistant positions are also included as part of this proposal with two being added in Year 2 and four in Year 3. The pay rate per GTA position is \$19,500. Also, due to the anticipated increased office administrative support, \$5,000 per year is included to offset costs for the single professional staff position in the Department of Geography and Geospatial Sciences.

For budgeting purposes, all salary estimates (faculty, administrative support, graduate teaching assistants, and support staff) include a 1% pay increase after the first fiscal year. Fringe benefit rates are applied at the current rates in use at Kansas State University (Kansas State University 2019a).

#### Personnel – New Positions

No new positions are required to initiate the proposed program.

#### Start-Up Costs – One-Time Expenses

The proposed program requires a one-time investment to expand the Kansas GeoSMART computer teaching laboratory within the Department of Geography and Geospatial Sciences to increase student capacity from its current level of 35 to its maximum of 40 in order to meet projected increases in course enrollments. The Kansas GeoSMART facility is an integrated learning and research space that combines state-of-the-art communications,

computing, visualization, GIS, remote sensing, and spatial analysis technologies and practices to develop learning, research, and outreach tools of the future using GIS&T approaches.

Expansion of the current space requires one additional table (for 5 students) and 5 chairs, In addition, a new glass wall will be installed in the GeoSMART laboratory to physically separate the teaching and research sides of the facility. The room is currently one large bay and the wall will improve security while maintaining the integrated nature of the space. Total estimated cost: \$18,000 (in Year 1).

The IT infrastructure to support increased enrollment will require updating and expansion. In Year 1, we will purchase and install two new data storage arrays to replace the current single server. The new system will be able to store (and backup) a minimum of 48 TB of instructional data. In addition, 5 new desktop computer workstations will be purchased to support single course enrollments to a maximum of 40 students each. Beginning Year 2, an additional virtual machine server will be acquired to support the anticipated increased demand for geographic information system and database servers in required classes. This equipment will also require one additional uninterrupted power supply. Total estimated cost: \$25,500 (\$22,500 in Year 1 and \$3,000 in Year 2)

Beginning in Year 2 of the program, we plan to seek accreditation through the United States Geospatial Intelligence Foundation (USGIF) and become the 16th non- military academy program in the U.S. to earn this recognition (USGIF 2020). Costs for accreditation include a fee and funds to support a 3-day site visit by two USGIF personnel. Total estimated cost: \$6,000 (in Year 2).

### **Operating Costs – Recurring Expenses**

Operating costs for supplies and equipment/technology are based on student credit hours for courses within the College of Arts and Sciences at the rates of \$4.00/SCH for supplies and \$8.00/SCH for equipment/technology. These costs represent the approximate expense of operating the GeoSMART teaching space (utilities and custodial services) as well as replacement parts for student computer workstations. Total estimated recurring cost: \$21,420 (\$2,520 in Year 1, \$6,660 in Year 2, and \$12,240 in Year 3)

Kansas State University operates a campus-wide software site license for GIS software from the Environmental Systems Research Institute (Esri). The annual cost is \$25,000 and is currently paid by KSU Libraries. Given the critical role played by GIS software in this proposed program, we plan to assist KSU Libraries by paying for 25% of this cost annually. Total estimated recurring cost: \$6,250/YR.

A subset of all student computer workstations in the Kansas GeoSMART computer teaching laboratory will be replaced periodically to keep classroom technology up to date. Beginning Year 2, we will purchase ten new computers each year to replace older machines in the teaching laboratory. This replacement cycle ensures no computer in the classroom is older than four years. Replaced machines will be repurposed in the Department of Geography and Geospatial Sciences to support other computer classrooms, office technology needs, and as graduate student office computers. Total estimated recurring cost: \$25,000/YR (starting Year 2).

Following successful accreditation by USGIF, the program will be required to submit an annual academic partner fee and participate in the USGIF Annual Summit. Total estimated recurring cost: \$4,000 (starting Year 3).

Kansas State University is currently a member of the University Consortium for Geographic Information Science (UCGIS), a non-profit organization that creates and supports communities of practice for GIScience research, education, and policy endeavors in higher education and allied institutions (UCGIS 2020). It is the professional hub for the academic GIS&T community in the United States. Approval of this program will strengthen the KSU member portfolio and provide a long-term mechanism to fund the annual member fee. Total estimated recurring cost: \$2,500/Year.

## B. Revenue: Funding Sources

The table below shows the total university revenue stream from tuition and fees generated by coursework taken by students in Years 1-3, including the small Academic Infrastructure Enhancement Fee collected by central administration. For on-campus and in-person courses, only the current in-state undergraduate tuition rate of \$312.50 and published fee schedules are used in this budget (Kansas State University 2019b). Similarly, the current KSU Global Campus tuition and fee schedule is incorporated for online courses (Kansas State University 2019c). Given the proposed curriculum, these amounts reflect that 77%, 20%, and 3% of all SCH will be generated by the Colleges of Arts and Sciences (COAS), College of Engineering (COE), and K-State Polytechnic (KSUP), respectively. All courses from the COE and KSUP are online and offered through K-State’s Global Campus, hence the “hybrid” modality of this proposed degree program. After Year 3, and depending on specialization electives selected by students, this percentage could change as courses from additional KSU colleges may be involved. The fee structures for other academic units such as the College of Agriculture; College of Architecture, Planning, and Design; College of Business; College of Veterinary Medicine; and Staley School of Leadership Studies are not factored into this budget analysis.

COAS has a general fee of \$16.70/SCH for on-campus courses, while the COE has a general fee of \$80/SCH, equipment fee of \$19/SCH, and distance education fee of \$190.70/SCH. KSUP currently lists no additional fees for the single online course that is part of this proposal. All funds generated by fees will be retained by the generating college. For COAS fees, 100% of the revenue generated for courses taught in the program will be returned to the Department of Geography and Geospatial Sciences to support the proposed program. Based on enrollment estimates, between \$8,673 and \$37,170 will be returned to KSU Global Campus for operation costs related to online courses that comprise parts of the proposed program.

28-31 SCH/YR	Tuition/SCH	SCH YR 1	Sub-Totals	SCH YR 2	Sub-Totals	SCH YR 3	Sub-Totals
In-State On-Campus Tuition	\$312.50	210	\$65,625	555	\$173,438	1,020	\$318,750
Global Campus Tuition	\$436.40	70	\$30,548	165	\$72,006	300	\$130,920
Academic Infrastructure Enhancement Fee	\$4.00	210	\$840	555	\$2,220	1,020	\$4,080
COAS Fees	\$16.70	210	\$3,507	555	\$9,269	1,020	\$17,034
COE Fees	\$289.70	70	\$20,279	135	\$39,110	255	\$73,874
KSUP Fees	\$0.00	0	\$0	30	\$0	45	\$0
<b>Total Incoming Revenue</b>		280	\$120,799	720	\$296,043	1,320	\$544,658

## C. Projected Surplus/Deficit

Our budget estimate suggests the cost of initiating this new major will be recovered in the first year and that the program will generate a revenue surplus from that point. Projected revenue is sufficient to maintain appropriate IT support infrastructure throughout the lifetime of the program at no additional cost to the department, college, or university.

## X. References

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