GEOSPATIAL SYSTEMS ENGINEERING, MS

Program Description

The Geospatial Systems Engineering Program will prepare graduates with advanced knowledge and skills focusing on research, design, development, and use of technologies in the field of geospatial systems engineering. This program satisfies regional, state, and national need for master's-level graduates in geospatial systems engineering.

The program offers two tracks, Track 1 - Geosensing Systems and UAS for Geomatics or Track 2 - Geospatial Data Science and Analytics. Both tracks require a minimum of 30 semester-credit hours. This must include 6 semester credit hours in the geospatial systems engineering core, 9 semester credit hours in each track, and 15 semester hours in the Graduate Thesis option or the Graduate Creative Project option as described in Section II.

Objectives of the Program

Student Learning Outcomes

Graduates of the GSEN Program will:

- Develop, manage, and analyze geospatial data using spatial analysis, computational, and geomatics engineering techniques.
- Develop the capacity for continued learning, research, and professional application.
- Creatively apply geomatics engineering techniques and technologies to solve real-world problems.

Program Outcomes

Graduates of the Master of Science in Geospatial Systems Engineering will have:

1. The ability to lead teams and apply problem-solving skills that include oral and written communication skills to effectively manage geospatial information.
2. An awareness and utilization of external organizations and institutions that provide useful geospatial data sets and their relationships to traditional and contemporary societal issues.
3. A recognition of the need for continued learning and development of leadership skills through involvement in volunteer professional organizations and societies.

Chronological Procedure Leading to the MS Degree

1. Completion of a degree plan
   Upon admission to the MS degree program in Geospatial Systems Engineering, and prior to enrollment in any course, *the student must contact the Graduate Academic Advisor in the College of Engineering to have a degree plan completed.* Students must arrange to see their advisor/mentor each semester until graduation to have their semester course schedules approved.
2. Progress toward the degree
   Once admitted to the graduate degree program in Geospatial Systems Engineering, a student must complete at least six semester credit hours per year toward the degree until the degree is completed. Failure to make this minimum progress will result in dismissal from the degree program with possible readmission based on the catalog in effect at the time of re-admission. A student who is actively pursuing a Coursework Option has completed all other course work for the degree will be required to register for a Graduate Creative Project with a minimum of three credit hours continuously until the project is completed. A student who is actively pursuing a Graduate Thesis and has completed all other course work for the degree will be required to register for thesis credit hour(s) continuously until the project is completed.
3. Graduate Thesis Procedure
   Students choosing the thesis option must obtain permission from their faculty advisor (who will chair their committee) to register GSEN 5397 Thesis I: Thesis Proposal (3sch) to develop a proposal for the Graduate Thesis. During the first month of Thesis I, the student and their advisor should determine the thesis committee. This committee consists of three full-time Texas A&M University-Corpus Christi graduate faculty members. The committee chairperson must be a graduate faculty member in the geospatial systems engineering program. The second committee member may be a graduate faculty member in geospatial systems engineering, geographic information science, computer science, or engineering. The third member may be a graduate faculty member having distinguished professional status and expertise in the discipline of the proposed Graduate Thesis. While taking Thesis I, the student will develop a written proposal of the thesis work and present the proposal for approval. Upon approval, the student may register for GSEN 5398 Thesis II: Thesis Research (3sch). While taking GSEN 5398 Thesis II, the student will produce a written thesis that discusses their work. The student must register GSEN 5399 Thesis III: Thesis Defense during the last semester before graduation in which they are planning to defend the thesis. While taking GSEN 5399 Thesis III, the student must pass an oral final thesis defense examination. The oral exam may include any material from the program of study and will be administered by the graduate committee. It will focus heavily on the thesis. Once a student has registered for GSEN 5399 Thesis III, the student must continue to register in each consecutive semester until the thesis is completed. A student who does not complete a thesis in the semester for which the student has registered will receive a grade of IP (I Progress). If the student fails to register for an incomplete thesis in the next semester or fails their final examination, a grade of No Credit will be assigned to GSEN 5397 Thesis I (3 sch), all GSEN 5398 Thesis II (3 sch) and all GSEN 5399 Thesis III (3 sch) courses and the student must begin the process again with the submission of a new thesis proposal.
4. The student is responsible for scheduling the defense in consultation with the graduate advisory committee while taking GSEN 5399 Thesis III (3sch). The thesis must be prepared in a standard format and style prescribed by the University. Upon approval by the student's graduate advisory committee, a copy of the thesis will be submitted to the Graduate Education website. For more information, see the Masters Student Handbook, available on the Graduate Education website.
5. Coursework Only Procedure
   Students must take all required courses including core courses, required courses, required courses for each track and elective courses. The required GSEN 5393 Graduate Creative Project (3sch) is taken in the final semester under the supervision by their faculty advisor.

For Additional Information

Website:
http://gsse.tamucc.edu (http://gisc.tamucc.edu)

Campus Address:
Center for Instruction, Room 301
Phone: 361-825-2474

Mailing Address:
Geospatial Systems Engineering Program, Unit 5825
Texas A&M University-Corpus Christi
6300 Ocean Drive
Corpus Christi, TX 78412-5868

Admission Requirements

Students seeking admission to the graduate degree program in Geospatial Systems Engineering must hold a bachelor's degree from a regionally accredited institution of higher education in the United States (or an equivalent foreign institution). In addition to meeting all University requirements, students seeking admission to the graduate degree program in Geospatial Systems Engineering must submit the following to Graduate Admissions:

1. An application and application fee.
2. Transcripts from regionally accredited institutions (international students will be required to submit relevant international transcripts).
3. At least two reference letters.
4. An Essay (500-1000 words) discussing why you wish to get a Master's degree in Geospatial Systems Engineering and your area of interest.
5. A 60 hr. GPA of 3.0 or higher is standard.

Students interested in the Thesis Option for the MS program in Geospatial Systems Engineering should contact the program and identify a faculty advisor. Coursework option students are also encouraged to identify a faculty advisor as well.

Program Requirements

Requirements for the Master of Science in Geospatial Systems Engineering degree may be met through one of two options: Thesis Option or Course Only Option. Both require a minimum of 30 credit hours with offering two tracks: Geosensing Systems and UAS for Geomatics (Track 1) and Geospatial Data Science and Analytics (Track 2).

The program normally requires 18 semester-credit hours of required courses, including 9 semester-credit hours of core courses and 9 semester-credit hours of required courses for tracks. Justification for exceptions to this rule should be prepared by students, approved by students' graduate advisor, and attached to the degree plan when submitted for the department head's signature.

General Prerequisites

1. Geospatial Systems Engineering
   Every student is expected to have achieved certain minimum competencies in geospatial science before being formally admitted to the MS degree program. Students who have not earned a baccalaureate degree in Geographic Information Science, Surveying, or a similar field must consult with the coordinator of the Geospatial Systems Engineering Program to design a plan of appropriate leveling courses. Leveling courses are not counted in the above 30 semester-credit hours requirements.
2. Mathematics
   Every student must have minimum level of knowledge in mathematics equivalent to the mathematics courses in the BS in Geographic Information Science Program and will be evaluated on an individual basis by Geospatial Systems Engineering faculty.
3. English
   Every student is expected to have minimum competencies in English composition, especially in technical writing. In preparation for reports that are required in the workplace, numerous reports are required during the course of study for the degree. The proposal, the creative project and the thesis require technical writing.

Track Options

Students must choose one from the following tracks:

- Track 1 Geosensing Systems and UAS for Geomatics
- Track 2 Geospatial Data Science and Analytics

The student can choose either a Thesis Option or a Coursework Option under their chosen track.

Thesis Option

A Graduate Thesis based upon original research, supported by the scientific literature, and proved statistically, will be required under this option. The thesis option master's degree will allow a person to pursue advanced graduate study, or to obtain employment in most areas requiring a detailed knowledge of specific aspects of geospatial systems engineering. The Geospatial Systems Engineering Graduate Thesis requires a minimum of 9 hours of GSEN 5397 Thesis I (3 sch), GSEN 5398 Thesis II (3 sch) and GSEN 5399 Thesis III (3 sch) and formal publishable thesis.

Thesis Option Track 1 or 2

Code	Title	Hours
Core Courses		9
Required Courses for Each Track		9
Electives (approved by faculty advisor)		3
GSEN 5397	Thesis I: Thesis Proposal	3
GSEN 5398	Thesis II: Thesis Research	3
GSEN 5399	Thesis III: Thesis Defense	3
Total Hours		**30**

Coursework Option

The Coursework option allows the student to be flexible in choosing elective courses but requires the student to complete a specific geospatial systems engineering project. The curriculum will especially benefit individuals employed in scientific or technical fields who seek advancement or additional training to enhance their knowledge and skills. The Coursework Option requires 3 hours of GSEN 5393 Graduate Creative Project (3 sch) and a project report.

Coursework Option Track 1 or 2

Code	Title	Hours
Core Courses		9
Required Courses for Each Track		9
Electives (approved by faculty advisor)		9
GSEN 5393	Graduate Creative Project	3
Total Hours		**30**

Degree Requirements

Track 1: Geosensing Systems and UAS for Geomatics - Thesis Option

Code	Title	Hours
Core Courses		
GSEN 6395	Geospatial Engineering Research	3
GSEN 6383	Advanced Geospatial Analytics	3
GSEN 6386	Remote Sensing and Image Analysis *	3
Required Courses [1]		
GSEN 6370	UAS for Surveying and Mapping *	3
GSEN 6371	Geopositioning Systems and Autonomous Navigation *	3
GSEN 6385	Photogrammetric Engineering and Lidar Scanning *	3
Electives		
Select 3 hours from the following Electives list except for the courses listed in above Required Courses (p. 4) [2]		3
Thesis Option		
GSEN 5397	Thesis I: Thesis Proposal	3
GSEN 5398	Thesis II: Thesis Research	3
GSEN 5399	Thesis III: Thesis Defense	3
Additional Courses		
The following may be offered and substituted for any of the courses above subject to approval by the student graduate mentor or committee chair:		
GSEN 6390	Advanced Topics	
GSEN 6396	Directed Independent Study [3]	
Total Hours		**30**

1. One core course in each track can be replaced with an elective course at the discretion of the graduate advisor and approval by the program coordinator.
2. Electives may be selected from other interdisciplinary courses, as selected in consultation with their advisory committee, to provide a broad background in geospatial systems engineering or related fields.
3. A maximum of six hours of approved Directed Independent Study may count toward the MS degree.

* Online offering

Track 1: Geosensing Systems and UAS for Geomatics - Coursework Option

Code	Title	Hours
Core Courses		
GSEN 6395	Geospatial Engineering Research	3
GSEN 6383	Advanced Geospatial Analytics	3
GSEN 6386	Remote Sensing and Image Analysis *	3
Required Courses [1]		
GSEN 6370	UAS for Surveying and Mapping *	3
GSEN 6371	Geopositioning Systems and Autonomous Navigation *	3
GSEN 6385	Photogrammetric Engineering and Lidar Scanning *	3
Electives		
Select 9 hours from the following Electives list except for the courses listed in above Required Courses (p. 4) [2]		9
Project Option		
GSEN 5393	Graduate Creative Project	3
Additional Courses		
The following may be offered and substituted for any of the courses above subject to approval by the student graduate mentor or committee chair:		
GSEN 6390	Advanced Topics	
GSEN 6396	Directed Independent Study [3]	
Total Hours		**30**

1. One core course in each track can be replaced with an elective course at the discretion of the graduate advisor and approval by the program coordinator.
2. Electives may be selected from other interdisciplinary courses, as selected in consultation with their advisory committee, to provide a broad background in geospatial systems engineering or related fields.
3. A maximum of six hours of approved Directed Independent Study may count toward the MS degree.

* Online offering

Track 2: Geospatial Data Science and Analytics - Thesis Option

Code	Title	Hours
Core Courses		
GSEN 6395	Geospatial Engineering Research	3
GSEN 6383	Advanced Geospatial Analytics *	3
GSEN 6386	Remote Sensing and Image Analysis	3
Required Courses [1]		
GSEN 6365	Spatial Database Design *	3
GSEN 6367	Geospatial Data Mining *	3
GSEN 6384	Geospatial Visualization Design *	3
Electives		
Select 3 hours from the following Electives list except for the courses listed in above Required Courses (p. 4) [2]		3
Thesis Option		
GSEN 5397	Thesis I: Thesis Proposal	3
GSEN 5398	Thesis II: Thesis Research	3
GSEN 5399	Thesis III: Thesis Defense	3
Additional Courses		
The following may be offered and substituted for any of the courses above subject to approval by the student graduate mentor or committee chair:		
GSEN 6390	Advanced Topics	
GSEN 6396	Directed Independent Study [3]	
Total Hours		**30**

1. One core course in each track can be replaced with an elective course at the discretion of the graduate advisor and approval by the program coordinator.
2. Electives may be selected from other interdisciplinary courses, as selected in consultation with their advisory committee, to provide a broad background in geospatial systems engineering or related fields.
3. A maximum of six hours of approved Directed Independent Study may count toward the MS degree.

* Online offering

Track 2: Geospatial Data Science and Analytics - Coursework Option

Code	Title	Hours
Core Courses		
GSEN 6395	Geospatial Engineering Research	3
GSEN 6383	Advanced Geospatial Analytics *	3
GSEN 6386	Remote Sensing and Image Analysis	3
Required Courses [1]		
GSEN 6365	Spatial Database Design *	3
GSEN 6367	Geospatial Data Mining *	3
GSEN 6384	Geospatial Visualization Design *	3
Electives		
Select 9 hours from the following Electives list except for the courses listed in above Required Courses (p. 4) [2]		9
Project Track		
GSEN 5393	Graduate Creative Project	3
Additional Courses		
The following may be offered and substituted for any of the courses above subject to approval by the student graduate mentor or committee chair:		
GSEN 6390	Advanced Topics	
GSEN 6396	Directed Independent Study [3]	
Total Hours		**30**

[1] One core course in each track can be replaced with an elective course at the discretion of the graduate advisor and approval by the program coordinator.

[2] Electives may be selected from other interdisciplinary courses, as selected in consultation with their advisory committee, to provide a broad background in geospatial systems engineering or related fields.

[3] A maximum of six hours of approved Directed Independent Study may count toward the MS degree.

* Online offering

Electives

Code	Title	Hours
GSEN 6330	Spatial Systems Science	3
GSEN 6355	Geospatial Programming Techniques	3
GSEN 6356	Programming for Geospatial Data Science	3
GSEN 6365	Spatial Database Design	3
GSEN 6367	Geospatial Data Mining	3
GSEN 6370	UAS for Surveying and Mapping	3
GSEN 6371	Geopositioning Systems and Autonomous Navigation	3
GSEN 6380	Applied Geospatial Statistics	3
GSEN 6381	Cadastral Information Systems Design	3
GSEN 6382	Policy and Legal Aspects of Spatial information Systems	3
GSEN 6384	Geospatial Visualization Design	3
GSEN 6385	Photogrammetric Engineering and Lidar Scanning	3
MATH 5315	Statistical Methods in Research I	3
MATH 5316	Statistical Methods in Research II	3
COSC 6324	Digital Image Processing	3
COSC 6326	Computer Vision	3
COSC 6338	Machine Learning	3
COSC 6339	Deep Learning	3
COSC 6380	Data Analytics	3

No more than six hours of approved electives may come from courses taken at another university. Credit from a master's degree earned at another institution will not be applied to a second master's degree at Texas A&M University-Corpus Christi.

Courses

GSEN 5393 Graduate Creative Project
3 Semester Credit Hours
An applied research group project in geospatial surveying engineering from problem definition to implementation in an area provided by faculty in the course of study.

GSEN 5397 Thesis I: Thesis Proposal
3 Semester Credit Hours (3 Lecture Hours)
This course is for Geospatial Systems Engineering MS students choosing the thesis option. Preparatory and developmental research for the graduate thesis resulting in the preliminary design and formal proposal of the graduate project. This thesis proposal must be reviewed and approved by the project chairperson to receive credit. Offered on a credit/no-credit basis only.

GSEN 5398 Thesis II: Thesis Research
3 Semester Credit Hours
This course is for Geospatial Systems Engineering MS students choosing the thesis option. Students will register for this course after completing GSEN 5397 Thesis I: Thesis Proposal. This course is only credit/no credit.
Prerequisite: GSEN 5397*.
* May be taken concurrently.

GSEN 5399 Thesis III: Thesis Defense
3 Semester Credit Hours (3 Lecture Hours)
This course is for Geospatial Systems Engineering MS students choosing the thesis option. Students will register for this course after completing GSEN 5398 Thesis II: Thesis Research. This course is only offered on a satisfactory/unsatisfactory (S/U) basis only, with grade of IP until completed. Credit will not be recorded until thesis is accepted by the Graduate Project Committee. May be repeated for credit.
Prerequisite: GSEN 5398.

GSEN 6330 Spatial Systems Science
3 Semester Credit Hours (3 Lecture Hours)
Geospatial data management and analysis is a fundamental activity in describing, documenting, and modeling the built and natural environment. This course examines the use of various types of geospatial data, including remote sensing data, for characterization of geospatial phenomena. Topics covered include geodetic datums and coordinate systems, digital representation of geospatial data, positional accuracy and error propagation, spatial analysis and modeling techniques, and emerging topics such as geospatial AI. A GIS (ArcGIS Pro) will be used to investigate and visualize patterns and relationships using various types of geospatial data sets. Familiarity with basic concepts of probability and statistics; familiarity with calculus and matrix algebra is helpful for some topics though not required; experience working with ArcGIS or other GIS software is helpful.

GSEN 6355 Geospatial Programming Techniques
3 Semester Credit Hours (3 Lecture Hours)
Course teaches programming techniques in geospatial fields, such as how to automate GIS tasks using Python and other scripting languages. Automation can make your work easier, faster, and more accurate, and knowledge of a scripting language is a highly desired skill in GIS analysts.

GSEN 6356 Programming for Geospatial Data Science
3 Semester Credit Hours (3 Lecture Hours)
Handling, processing and analyzing spatial data in an open and reproducible way is critical in the emergence of geospatial data science. Various open source packages and tools for geospatial data and process are available and they provide an effective solution for flexibility, reproducibility and transparency in geospatial research and analysis. This course focuses on various programming skills in handling and manipulating spatial data through open source environments. Creating spatial database and queries, exploring spatial data, modeling spatial data, and visualizing spatial data through open source packages will be covered.

GSEN 6365 Spatial Database Design
3 Semester Credit Hours (3 Lecture Hours)
This course will focus on spatial database principles and the practical skills of design, implementation, and use of spatial databases. This course will first cover fundamentals of relational database design, and then focus on design and management of spatial databases utilizing geodatabase models. In addition, case studies of geodatabase design models in several applications will also be covered. This course is intended for students who want to design, create, maintain and manipulate data from a geospatial database.

GSEN 6367 Geospatial Data Mining
3 Semester Credit Hours (3 Lecture Hours)
Geospatial data mining is the process of automatically discovering interesting and useful spatial patterns in large geospatial datasets. This course begins by covering fundamental concepts and techniques in data mining. Specific topics covered include classification, association analysis, and cluster analysis. It then focuses on using these data mining techniques for handling spatial, temporal and spatial-temporal data. In addition, the data mining tools to implement applications in geoscience will also be covered.

GSEN 6370 UAS for Surveying and Mapping
3 Semester Credit Hours (3 Lecture Hours)
Introduces the fundamentals of mapping with small Unmanned Aircraft Systems (sUAS) using digital imaging sensors to produce high resolution, accurate geospatial surveying products. The course will cover the full spectrum of UAS mapping including technology, current regulations, operational factors, flight design, photogrammetric data processing, and data fidelity. Supporting concepts will include georeferencing and ground control, 3D reconstruction with structure-from-motion photogrammetry, orthorectification and image mosaicking, accuracy assessment, and current developments in UAS for geomatics. Processing and analysis workflows using commercial and open-source software will be conducted to transform UAS image sequences into geospatial data products, extract analytics, assess results, and optimize output.

GSEN 6371 Geopositioning Systems and Autonomous Navigation
3 Semester Credit Hours (3 Lecture Hours)
Addresses the foundations and computational techniques of Global Navigation Satellite Systems (GNSS) and inertial measurement units (IMUs) for autonomous navigation applications. Specifically, the course will cover concepts and principles of GNSS signal structures and the derivation of observables; error sources and corrections; point, differential, and kinetic positioning techniques; IMU linear and angular dynamics modeling; mechanization of inertial navigation and error propagation; global/local coordinate frames and conversion; and filtering techniques for GNSS/IMU integration. The course also covers current and future capabilities of emerging geopositioning systems as they relate to autonomous navigation and mobile devices.

GSEN 6380 Applied Geospatial Statistics
3 Semester Credit Hours (3 Lecture Hours)
This course will focus on geospatial statistics methods particularly multivariate statistics and applications of the statistical procedures to research geospatial problems. Research on geospatial problems often requires the application of multivariate statistical methods to produce new insight. Various existing statistic software is available to conduct multivariate statistical analysis, however, the interpretation of the results rely on solid understanding of statistic principles and theories. This course is intended for students who want to apply statistical methods to research geospatial problems.

GSEN 6381 Cadastral Information Systems Design
3 Semester Credit Hours (3 Lecture Hours)
A review of the evolution of European cadastral systems and land records traditions and alternatives. Examination of the goals and purposes of land tenure systems with attention to social, political, legal, economic, organizational, and technical issues. Exploration of U.S. modernization efforts and the problems of developing countries.

GSEN 6382 Policy and Legal Aspects of Spatial information Systems
3 Semester Credit Hours (3 Lecture Hours)
A study of the current and emerging status of computer law in electronic environments. Covers issues related to: privacy, freedom of information, confidentiality, copyright, and legal liability; the impact of statue and case law on use of digital databases and spatial databases; and research of legal options of conflicts related to spatial data. Additional description: study of specific court cases specific to Texas boundary law. Introduction into International Boundaries and Treaties.

GSEN 6383 Advanced Geospatial Analytics
3 Semester Credit Hours (3 Lecture Hours)
This course will focus on the theory, techniques, and applications of advanced geospatial analytics. Topics covered include spatial point patterns, network analysis, area objects and spatial autocorrelation, and spatial interpolation. New approaches to geospatial analytics will also be covered. This course emphasizes the methods and the applied side of geospatial analytics that can be useful in students' own theses or projects for their current or potential employers.

GSEN 6384 Geospatial Visualization Design
3 Semester Credit Hours (3 Lecture Hours)
In a world filled with massive, complex, dynamic, and multi-dimensional information, creating visual representations can be both challenging and demanding. This course explores geospatial data visualization by integrating aesthetic and cognitive principles to assist students in effectively exploring, communicating, and analyzing both spatial and non-spatial data. Students will learn the foundational principles of visual communication and visual thinking, empowering them to design effective visualizations and evaluate geospatial data visualization products.

GSEN 6385 Photogrammetric Engineering and Lidar Scanning
3 Semester Credit Hours (3 Lecture Hours)
A study of the analytical and systems engineering foundations of airborne photogrammetry and geodetic imaging technologies for 2D and 3D mapping of natural and built environments. The course covers principles of digital imaging, camera calibration, stereo and multi-view photogrammetry, analytical photogrammetry, structure-from-motion, light detection and ranging (lidar) systems, and emergent scanning and imaging approaches. The course also details photogrammetric and lidar data processing, point cloud analysis, and applications.

GSEN 6386 Remote Sensing and Image Analysis
3 Semester Credit Hours (3 Lecture Hours)
Addresses the interpretation, processing and analysis techniques of remotely sensed data acquired by orbital and sub-orbital platforms. Physical principles and imaging mechanisms, remote sensing systems, data characteristics, image processing, and information extraction methods will be covered. Topics include passive optical imaging with multispectral, hyperspectral, and thermal sensing; active imaging with radar sensing; image corrections and rectification; spatial/frequency transforms and image filtering; image classification and feature extraction; and image processing with machine learning techniques. Applications in the course will be focused on geomatics and monitoring of natural and built environments.

GSEN 6390 Advanced Topics
3 Semester Credit Hours (3 Lecture Hours)
Variable content study of specific areas of geospatial surveying engineering. May be repeated for credit when topics vary. Offered on sufficient demand.

GSEN 6395 Geospatial Engineering Research
3 Semester Credit Hours (3 Lecture Hours)
Seminar in reading and critical evaluation of academic literature in the fields relating to geospatial engineering. Research methods for geospatial engineering will be introduced. Student will design, implement, and evaluate an advanced, contemporary geospatial engineering technology to solve a geospatial problem.

GSEN 6396 Directed Independent Study
3 Semester Credit Hours (3 Lecture Hours)
Study in areas of current interest. A maximum of 6 SCH of approved Directed Independent Study may count toward the MS degree.