

# GEOSPATIAL COMPUTER SCIENCE, PHD

## Program Description

The Geospatial Computer Science (GSCS) doctoral program is an interdisciplinary program intended to train geospatially minded computer science scholars into accomplished researchers able to make significant contributions in geospatial computing. Students learn important fundamental theory in computation and geospatial science and apply it towards cutting-edge research in areas such as those listed below. The GSCS program is a unique combination of computer science and geospatial science able to position graduates as leaders in the field of geospatial computer science.

The Geospatial Computer Science Ph.D. program will:

- Develop students into experts in geospatial computer science.
- Train students to conduct and publish new research in geospatial computer science, including such topics as big data analytics for geocomputation, autonomous systems, remote sensing, structure from motion photogrammetry, machine learning-driven geospatial knowledge discovery, mobile computing for location-based services, and high-performance computing for spatial optimization.
- Produce researchers who will be able to pursue careers in higher education, government, or industry related to or affected by geospatial computer science.
- Educate students in the collecting, processing, analyzing, and visualizing of geospatial data, as well as the utilization of geospatial methods and data for developing new technologies.
- Provide students with a rigorous preparation to use computer science theoretical and applied techniques to pursue research and scholarship that will advance the state of knowledge in geospatial computer science.

## Student Learning Outcomes

The program's student learning outcomes are for students to:

- Produce innovative research that advances theory or methodology in geospatial computing science.
- Participate at academic conferences and publish in peer-reviewed journals.
- Find employment in research departments of public and private organizations, in major academic institutions, and in industry.
- Advance the science of computing to create new algorithms and applications for geospatial challenges.
- Acquire the computer science and geospatial analysis skills necessary to advance the theory and methodology of geospatial computing science.
- Develop the professional skills necessary to present research outcomes orally to a professional or general audience as well as in writing for peer reviewed journals and conference proceedings.

## For Additional Information

**Website:**  
[http://gradschool.tamucc.edu/degrees/science/geo\\_comp\\_sci.html](http://gradschool.tamucc.edu/degrees/science/geo_comp_sci.html)

## Campus Address:

Center for Instruction, Room 301  
 Phone: (361) 825-2474

**Mailing Address:**  
 Geospatial Computer Science  
 Program, Unit 5825  
 College of Science and Engineering  
 Texas A&M University-Corpus  
 Christi  
 6300 Ocean Drive  
 Corpus Christi, Texas 78412-5825

## Admission Requirements

1. Persons seeking admission to the GSCS program should first contact the program to identify a faculty member willing to serve as their graduate advisor. Applicants will not be admitted to the program without a graduate faculty advisor.
2. In addition to meeting all University requirements, students seeking admission to the graduate degree program in Geospatial Computer Science must submit the following to the Office of Recruitment and Admissions:
  - An application and application fee,
  - Transcripts from regionally accredited institutions (international students will be required to submit relevant international transcripts),
  - An essay (500-1000 words) discussing why you are seeking admission to the program and what your research plans are,
  - A curriculum vitae,
  - GRE scores (within five years of the date of application), and
  - International students must submit TOEFL or IELTS scores and additional documents to the Office of Recruitment and Admissions. <http://gradschool.tamucc.edu/international.htm>
3. A student entering the program is expected to have adequate preparation in computer science, geographic information science, and mathematics. For computer science, this preparation must include successful completion of coursework in a high-level programming language. For geospatial science, students must have successfully completed course work in geospatial data analysis and visualization. In mathematics, students must have successfully completed course work in calculus plus one additional junior level or higher mathematics course such as linear algebra, numerical analysis, or applied probability and statistics.

Students who have not successfully completed the above courses may be required to take leveling courses in any missing subjects before being formally admitted into the program. Leveling coursework does not count towards the total credit hours required for the degree. All leveling courses must be completed with a grade of "B" or better. While taking leveling courses, a student can take regular courses that can be counted towards the degree once admitted into the program formally. However, the total credit hours of such courses must not exceed nine hours.

## Program Requirements

There are two paths for students in the PhD in Geospatial Computer Science degree program, those coming in with

1. a bachelor's degree in a related field, and
2. a master's degree in a related field.

Students entering the program with a bachelor's degree are required to take a minimum of 75 semester credit hours (SCH). Of these 75 SCH, students must take the GSCS core courses (12 SCH), 3 SCH of Graduate Seminar, at least 27 hours of Electives, and at least 30 hours of research and dissertation credits.

Students entering the program with a master's degree are required to take a minimum of 57 credit hours beyond the master's degree. Students are required to take the GSCS core courses (12 SCH). At least 9 hours of elective courses must also be taken at TAMUCC. Three credit hours of Graduate Seminar and at least 30 hours of dissertation and research must also be part of the required 57 hours.

Additional courses may be assigned depending on the student's background.

Students must file an approved degree plan by the end of their second semester in the program.

| Code  | Title  | Hours |
|---|--|-------|
| <b>Core Courses</b> <sup>1</sup>                                |  |       |
| COSC 6334   | Design and Analysis of Algorithms              | 3     |
| COSC 6380   | Data Analytics                                 | 3     |
| GSCS 6321   | Geospatial Data Structures                     | 3     |
| GSCS 6331   | Advanced Geospatial Computing                  | 3     |
| <b>Required Courses</b>   |  |       |
| GSCS 6302   | Graduate Seminar                               | 3     |
| Select 30 hours of research and defense from the following:     |  | 30    |
| GSCS 6996   | Research                                       |       |
| GSCS 6998   | Dissertation Research                          |       |
| GSCS 6999   | Dissertation Defense (minimum of 3 sem. hours) |       |
| <b>Elective Courses</b>   |  |       |
| Select 9-27 hours of electives from the following: <sup>2</sup> |  | 9-27  |
| COSC 6327   | Introduction to Computer Graphics              |       |
| COSC 6328   | Advanced Computer Graphics                     |       |
| COSC 6334   | Design and Analysis of Algorithms              |       |
| COSC 6336   | Database Management Systems                    |       |
| COSC 6339   | Deep Learning                                  |       |
| COSC 6340   | Human-Computer Interaction                     |       |
| COSC 6350   | Advanced Topics in DBMS                        |       |
| COSC 6351   | Advanced Computer Architecture                 |       |
| COSC 6352   | Advanced Operating Systems                     |       |
| COSC 6353   | Compiler Design and Construction               |       |
| COSC 6354   | Artificial Intelligence <sup>^</sup>           |       |
| COSC 6355   | Data Communications and Networking             |       |
| COSC 6356   | Theory of Computation                          |       |
| COSC 6357   | Wireless Sensor Networks                       |       |
| COSC 6360   | Parallel Computing                             |       |
| COSC 6338   | Machine Learning                               |       |
| COSC 6361   | Parallel Algorithms                            |       |
| COSC 6362   | Mobile Software Development                    |       |
| COSC 6370   | Advanced Software Engineering <sup>^</sup>     |       |
| COSC 6374   | Computer Forensics <sup>^</sup>                |       |
| COSC 6375   | Information Assurance <sup>^</sup>             |       |
| COSC 6376   | Network Security <sup>^</sup>                  |       |
| COSC 6377   | Applied Cryptography                           |       |

|           |   |
|-----------|---|
| COSC 6379 | Advanced Information Assurance <sup>^</sup>                 |
| COSC 6590 | Selected Topics   |
| GSCS 6329 | Scientific Visualization                                    |
| GSCS 6344 | Ubiquitous Positioning                                      |
| GSCS 6390 | Special Topics  |
| COSC 6393 | Research Methods in Computer Science                        |
| GSEN 6330 | Spatial Systems Science <sup>*</sup>                        |
| GSEN 6355 | Geospatial Programming Techniques <sup>*</sup>              |
| GSEN 6365 | Spatial Database Design <sup>*</sup>                        |
| GSEN 6381 | Cadastral Information Systems Design <sup>*</sup>           |
| GSEN 6383 | Advanced Geospatial Analytics <sup>*</sup>                  |
| GSEN 6384 | Geospatial Visualization Design <sup>*</sup>                |
| GSEN 6385 | Photogrammetric Engineering and Lidar Scanning <sup>*</sup> |
| GSEN 6386 | Remote Sensing and Image Analysis <sup>*</sup>              |
| GSEN 6390 | Advanced Topics <sup>*</sup>                                |
| MATH 6344 | Spatial Statistics  |

**Total Hours** **54-72**

<sup>1</sup> All students must master the same core knowledge, and this content must be mastered prior to their candidacy exam. Students entering with a master's degree must take at least three (9SCH) of the following courses at Texas A&M University-Corpus Christi, and may be required to take more to fill any deficiencies.

<sup>2</sup> At least 27 hours of electives must be taken by students entering with a bachelor's degree, 9 hours of electives by students entering with a master's degree. Electives will predominately come from COSC, GSCS, and GSEN graduate courses. Up to 6 hours can be from another graduate program with approval.

<sup>\*</sup> Online offering

<sup>^</sup> Blended offering

## Courses

### Computer Science Courses

#### COSC 5300 Introductory Topics in Computer Science 3 Semester Credit Hours (3 Lecture Hours)

THIS COURSE INTRODUCES STUDENTS TO THE LEVELING TOPICS IN COMPUTER SCIENCE. THIS COURSE SERVES THE NEEDS OF CERTAIN TOPICS STUDENTS LACK FOR PURSUING A MASTER'S DEGREE IN COMPUTER SCIENCE. GRADE ASSIGNED WILL BE "CREDIT" (CR) OR "NO CREDIT" (NC).

#### COSC 5313 Foundations of Computer Organization and Architecture 3 Semester Credit Hours (3 Lecture Hours)

A STUDY OF INTERNAL COMPUTER CONCEPTS WITH RESPECT TO THE FUNCTIONING OF THE HARDWARE SUBSYSTEMS AND THEIR ROLES IN THE COMPUTING PROCESS. AN IN-DEPTH STUDY OF MACHINE AND ASSEMBLY LANGUAGE. (DOES NOT COUNT TOWARD TOTAL HOURS REQUIRED FOR MS IN COMPUTER SCIENCE.)

**COSC 5320 DESIGN AND IMPLEMENTATION OF COMPUTERIZED INSTRUCTIONAL SYSTEMS****3 Semester Credit Hours (3 Lecture Hours)**

PROVIDES A BROAD INTRODUCTION TO THE DEVELOPMENT OF COMPUTER-BASED LEARNING ENVIRONMENTS. COVERS THE THEORY AND PRACTICE OF USING THE COMPUTER BOTH IN THE CLASSROOM AND INDIVIDUALLY FOR LEARNING. COVERS A WIDE RANGE OF POSSIBILITIES FROM MULTIMEDIA PRESENTATION OF MATERIAL TO CONSTRUCTIVE ENVIRONMENTS AND COMPUTER-BASED INSTRUCTIONAL SYSTEMS.

**COSC 5321 Data Structures****3 Semester Credit Hours (3 Lecture Hours)**

A STUDY OF THE LOGICAL STRUCTURES USED FOR THE ORGANIZATION, STORAGE AND RETRIEVAL OF DATA. THESE STRUCTURES ARE ADDRESSED FROM BOTH MEMORY-RESIDENT AND FILE-RESIDENT POINTS OF VIEW. ALGORITHMS FOR THE CREATION, SEARCHING, AND MANIPULATION OF STANDARD DATA STRUCTURES USED IN COMPUTING ARE STRESSED. (DOES NOT COUNT TOWARD TOTAL HOURS REQUIRED FOR MS IN COMPUTER SCIENCE.)

**Co-requisite:** COSC 5312, MATH 2305.

**COSC 5324 DIGITAL IMAGE PROCESSING****3 Semester Credit Hours (3 Lecture Hours)****COSC 5326 COMPUTER VISION****3 Semester Credit Hours (3 Lecture Hours)**

**Prerequisite:** COSC 5324.

**COSC 5327 INTRO TO COMPUTER GRAPHICS****3 Semester Credit Hours (3 Lecture Hours)**

INTRODUCTION TO COMPUTER GRAPHICS This graduate course provides students with a foundation in basic principles and techniques for computer graphics on modern graphics hardware. Students will gain experience in interactive computer graphics using the OpenGL API. Topics include: graphics hardware, rendering, perspective, lighting, and geometry.

**COSC 5328 ADVANCED COMPUTER GRAPHICS****3 Semester Credit Hours (3 Lecture Hours)**

This course covers advanced computer graphics techniques. Students will be introduced to state-of-the-art methods in computer graphics. This course will focus on techniques for real-time rendering and animation.

**Prerequisite:** COSC 4328 or 5327.

**COSC 5331 Foundations of Computer System Software****3 Semester Credit Hours (3 Lecture Hours)**

INTRODUCTION TO OPERATING SYSTEMS CONCEPTS, PRINCIPLES, AND DESIGN. TOPICS INCLUDE: PROCESSES AND THREADS, CPU SCHEDULING, MUTUAL EXCLUSION AND SYNCHRONIZATION, DEADLOCK, MEMORY MANAGEMENT, FILE SYSTEMS, SECURITY AND PROTECTION, NETWORKING, AND DISTRIBUTED SYSTEMS. SELECTED EXISTING OPERATING SYSTEMS ARE DISCUSSED, COMPARED, AND CONTRASTED. (DOES NOT COUNT TOWARD TOTAL HOURS REQUIRED FOR MS IN COMPUTER SCIENCE.)

**Prerequisite:** COSC 5313.

**Co-requisite:** COSC 5321.

**COSC 5334 THE DESIGN AND ANALYSIS OF ALGORITHMS****3 Semester Credit Hours (3 Lecture Hours)**

An advanced course that concentrates on the design and analysis of algorithms used to solve a variety of problems. The methods of design covered include such topics as: divide-and-conquer, the greedy method, dynamic programming, search and traversal techniques, and backtracking.

**Prerequisite:** COSC 5321, MATH 2413 and 2305.

**COSC 5336 DATABASE MANAGEMENT SYSTEMS****3 Semester Credit Hours (3 Lecture Hours)**

A study of contemporary database management concepts. Performance (indexing, query optimization, update optimization), concurrency, security and recovery issues are discussed. Also includes the study of front-end environments that access the database.

**Prerequisite:** COSC 5335 and 5321.

**COSC 5337 DATA MINING****3 Semester Credit Hours (3 Lecture Hours)****COSC 5340 HUMAN-COMPUTER INTERACTION****3 Semester Credit Hours (3 Lecture Hours)**

Graduate-level survey of the field of Human-Computer Interaction (HCI) focusing on design strategies for making software usable by real-world people for doing real-world work. Topics include the role of HCI in the software product life cycle, task analysis of the user's work, architectures for human-computer dialogues, new and traditional approaches to user interface design, and user interface standards.

**Prerequisite:** COSC 5331.

**COSC 5350 ADVANCED TOPICS IN DBMS****3 Semester Credit Hours (3 Lecture Hours)**

The study of emerging database technologies. Topics are chosen from data warehousing, distributed databases, spatial databases and web-based applications.

**Prerequisite:** COSC 5336.

**COSC 5351 ADVANCED COMPUTER ARCHITECTURE****3 Semester Credit Hours (3 Lecture Hours)**

COMPUTER ARCHITECTURE An overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing.

**Prerequisite:** COSC 5331.

**COSC 5352 ADVANCED OPERATING SYSTEMS****3 Semester Credit Hours (3 Lecture Hours)**

Introduction to advanced concepts in operating systems and distributed systems. Topics include distributed system architectures, interprocess communication, distributed mutual exclusion, distributed synchronization and deadlock, agreement protocols, distributed scheduling and process management, distributed shared memory, distributed file systems, multiprocessor system architectures and operating systems, recovery and fault tolerance.

**Prerequisite:** COSC 5331.

**COSC 5353 PRINCIPLES OF COMPILER CONSTRU****3 Semester Credit Hours (3 Lecture Hours)**

COMPILER DESIGN AND CONSTRUCTION This course introduces the basic concepts and mechanisms traditionally employed in language translators, with emphasis on compilers. Topics include strategies for syntactic and semantic analysis, techniques of code optimization and approaches toward code generation.

**Prerequisite:** COSC 5330 and MATH 2305.

**COSC 5354 ARTIFICIAL INTELLIGENCE****3 Semester Credit Hours (3 Lecture Hours)**

Fundamental concepts and techniques for the design of computer-based, intelligent systems. Topics include: a brief history, methods for knowledge representation, heuristic search techniques, programming in LISP or Prolog.

**Prerequisite:** COSC 5321 and MATH 2305.

**COSC 5355 DATA COMMUNICATIONS NETWORKING****3 Semester Credit Hours (3 Lecture Hours)**

DATA COMMUNICATION SYSTEMS Areas studied include principles of computer-based communication systems, analysis and design of computer networks, and distributed data processing.

**Prerequisite:** COSC 5331.

**COSC 5356 THEORY OF COMPUTATION****3 Semester Credit Hours (3 Lecture Hours)**

THEORETICAL ASPECTS OF COMPUTING An introduction to theoretical foundations of modern computing. Topics include finite state machine concepts, formal grammars, and basic computability concepts.

**Prerequisite:** COSC 5321 and MATH 2305.

**COSC 5357 WIRELESS SENSOR NETWORKS****3 Semester Credit Hours (3 Lecture Hours)**

This is a graduate level course on wireless sensor networks; one of the fastest developing areas in computer science and engineering. The focus of this course is on the design of optimized architectures and protocols for such unique networks. Topics include the design principles of wireless sensor networks, energy management, MAC protocols, naming and addressing, localization, routing protocols, applications of wireless sensor networks, and associated challenges and measures.

**COSC 5360 CONCURRENCY: PARALLEL AND DISTRIBUTED PROCESSING****3 Semester Credit Hours (3 Lecture Hours)**

PARALLEL COMPUTING Introduction to the hardware and software issues in parallel computing. Topics include motivation and history, parallel architectures, parallel algorithm design, and parallel performance analysis. Students will be introduced to a variety of parallel computing paradigms including message passing systems and shared memory systems.

**Prerequisite:** COSC 5331.

**COSC 5362 MOBILE SOFTWARE DEVELOPMENT****3 Semester Credit Hours (3 Lecture Hours)**

Survey of software development on mobile platforms including both native and cross-platform applications with topics such as: prototyping, programming, testing, debugging, and deploying. Coverage of software life cycle on mobile platforms and how mobile hardware differs from traditional computers. COSC 5321

**COSC 5370 ADVANCED SOFTWARE ENGINEERING****3 Semester Credit Hours (3 Lecture Hours)**

Areas studied include engineering principles and their application to the design, development, testing, and maintenance of large software systems, tools and processes for managing the complexities inherent in creating and maintaining large software systems.

**Prerequisite:** COSC 5321.

**COSC 5374 COMPUTER FORENSICS****3 Semester Credit Hours (3 Lecture Hours)**

This course will introduce students to the fundamentals of computer forensics and various software tools used in cyber-crime analysis. Students will be introduced to established methodologies for conducting computer forensic investigations, as well as to emerging international standards for computer forensics. Applicable laws and regulations dealing with computer forensic analysis will also be discussed.

**Prerequisite:** COSC 5312.

**COSC 5375 INFORMATION ASSURANCE****3 Semester Credit Hours (3 Lecture Hours)**

An introduction to information security and assurance. This course covers the basic notions of confidentiality, integrity, availability, authentication models, protection models, secure programming, audit, intrusion detection and response, operational security issues, physical security issues, personnel security, policy formation and enforcement, access controls, information flow, legal and social issues, classification, trust modeling, and risk assessment.

**Prerequisite:** COSC 5312.

**COSC 5376 NETWORK SECURITY****3 Semester Credit Hours (3 Lecture Hours)**

This course is a study of networking basics and security essentials with respect to information services provided over a computer network. The course covers the technical details of security threats, vulnerabilities, attacks, policies, and countermeasures such as firewalls, honeypots, intrusion detection systems, and cryptographic algorithms for confidentiality and authentication and the development of strategies to protect information services and resources accessible on a computer network.

**Prerequisite:** COSC 5375.

**COSC 5377 APPLIED CRYPTOGRAPHY****3 Semester Credit Hours (3 Lecture Hours)**

This course includes an introduction to cryptographic algorithms and protocols for encrypting information securely, techniques for analyzing vulnerabilities of protocols, approaches to digital signatures and information digests, and implementation approaches for the most significant cryptographic methodologies.

**Prerequisite:** COSC 5312.

**COSC 5379 ADVANCED INFORMATION ASSURANCE****3 Semester Credit Hours (3 Lecture Hours)**

This course encompasses a broad range of topics involving information security, communications security, network security, risk analysis, operational security, health information privacy, criminal justice digital forensics, homeland security, the human element and social engineering, and applicable national and international laws. An in-depth information assurance capstone project or research paper will be required of each student to satisfy the information assurance graduate option requirements.

**Prerequisite:** COSC 5375.

**COSC 5390 Internship****3 Semester Credit Hours**

INDIVIDUAL CONTRACT AGREEMENT INVOLVING STUDENT, FACULTY, AND COOPERATING AGENCY (DISCIPLINE-RELATED BUSINESS, NONPROFIT ORGANIZATION, OR GOVERNMENT AGENCY) TO GAIN PRACTICAL EXPERIENCE APPROPRIATE TO COMPUTER SCIENCE IN OFF-CAMPUS SETTING. GRADE ASSIGNED WILL BE "CREDIT" (CR) OR "NO CREDIT" (NC).

**COSC 5393 RESEARCH METHODS IN COMP SCIEN****3 Semester Credit Hours (3 Lecture Hours)**

RESEARCH METHODS IN COMPUTER SCIENCE This course provides students with a range of experiences in conducting and communicating research. Students will learn major research methods and techniques. Experiences will be gained in all stages of research: reviewing literature, writing a proposal, designing an approach, and reporting results. Critical-reading/writing assignments and class discussions on state-of-the-art research in Computer Science will provide students with major research aspects. Fall, Spring



**COSC 5395 GRADUATE PROJECT AND TECHNICAL REPORT****3 Semester Credit Hours**

AN APPLIED RESEARCH PROJECT IN COMPUTING FROM PROBLEM DEFINITION TO IMPLEMENTATION IN AN AREA OF PARTICULAR INTEREST TO THE STUDENT THAT RELATES TO THE COURSE OF STUDY.

**Prerequisite:** COSC 5393 and 5370.

**COSC 5396 DIRECTED INDEPENDENT STUDY****1-3 Semester Credit Hours**

Study in areas of current interest. (A maximum of six hours may be counted toward the MS degree.) Fall, Spring, Summer.

**COSC 5398 Thesis I****3 Semester Credit Hours (3 Lecture Hours)**

THIS COURSE IS FOR COMPUTER SCIENCE MS STUDENTS CHOOSING THE THESIS OPTION. UPON CHOOSING A THESIS ADVISOR, STUDENTS WILL REGISTER FOR THIS COURSE. THIS COURSE IS ONLY CREDIT/NO CREDIT. STUDENTS WILL BE GIVEN A GRADE OF IN-PROGRESS UNTIL SUCCESSFULLY COMPLETING THEIR THESIS.

**Prerequisite:** COSC 6393.

**COSC 5399 Thesis II****3 Semester Credit Hours (3 Lecture Hours)**

THIS COURSE IS FOR COMPUTER SCIENCE MS STUDENTS CHOOSING THE THESIS OPTION. STUDENTS WILL CONTINUALLY REGISTER FOR THIS COURSE UNTIL SUCCESSFUL COMPLETION OF THEIR THESIS. A GRADE OF IN-PROGRESS WILL BE ASSIGNED UNTIL EITHER SUCCESSFUL COMPLETION OR FAILING TO REGISTER. IF FAILING TO REGISTER STUDENTS WILL RECEIVE A GRADE OF NO CREDIT FOR ALL 5399 AND 5398 COURSES.

**Prerequisite:** COSC 5398.

**COSC 5590 SELECTED TOPICS****1-5 Semester Credit Hours (1-5 Lecture Hours)**

Variable content study of specific areas of computer and information systems. May be repeated for credit when topics vary. Offered on sufficient demand.

**COSC 5999 Advanced Research in Computer Science****1-9 Semester Credit Hours (1-9 Lecture Hours)**

ADVANCED WORK IN A SPECIALIZED AREA OF COMPUTER SCIENCE. DOES NOT COUNT AS CREDIT TOWARD A DEGREE IN COMPUTER SCIENCE. COURSE IS TAKEN AS CREDIT/NON-CREDIT.

**COSC 6324 Digital Image Processing****3 Semester Credit Hours**

THIS COURSE INTRODUCES CONCEPTS AND TECHNIQUES FOR IMAGE PROCESSING. THE OBJECTIVE OF THIS COURSE IS TO INTRODUCE THE FUNDAMENTAL TECHNIQUES AND ALGORITHMS USED FOR PROCESSING AND EXTRACTING USEFUL INFORMATION FROM DIGITAL IMAGES. THE STUDENTS WILL LEARN HOW TO APPLY THE IMAGE PROCESSING METHODS TO SOLVE REAL-WORLD PROBLEMS.

**COSC 6326 Computer Vision****3 Semester Credit Hours**

THIS GRADUATE COURSE INTRODUCES CONCEPTS AND TECHNIQUES FOR MACHINE VISION. PARTICULAR EMPHASIS WILL BE PLACED ON METHODS USED FOR OBJECT RECOGNITION, MACHINE LEARNING, CONTENT-BASED IMAGE RETRIEVAL, IMAGE MATCHING, 3D VISION, TRACKING AND MOTION ANALYSIS.

**Prerequisite:** COSC 6324.

**COSC 6327 Introduction to Computer Graphics****3 Semester Credit Hours**

THIS GRADUATE COURSE PROVIDES STUDENTS WITH A FOUNDATION IN BASIC PRINCIPLES AND TECHNIQUES FOR COMPUTER GRAPHICS ON MODERN GRAPHICS HARDWARE. STUDENTS WILL GAIN EXPERIENCE IN INTERACTIVE COMPUTER GRAPHICS USING THE OPENGL API. TOPICS INCLUDE: GRAPHICS HARDWARE, RENDERING, PERSPECTIVE, LIGHTING, AND GEOMETRY.

**COSC 6328 Advanced Computer Graphics****3 Semester Credit Hours**

THIS COURSE COVERS ADVANCED COMPUTER GRAPHICS TECHNIQUES. STUDENTS WILL BE INTRODUCED TO STATE-OF-THE-ART METHODS IN COMPUTER GRAPHICS. THIS COURSE WILL FOCUS ON TECHNIQUES FOR REAL-TIME RENDERING AND ANIMATION.

**Prerequisite:** COSC 4328 or 6327.

**COSC 6334 Design and Analysis of Algorithms****3 Semester Credit Hours (3 Lecture Hours)**

AN ADVANCED COURSE THAT CONCENTRATES ON THE DESIGN AND ANALYSIS OF ALGORITHMS USED TO SOLVE A VARIETY OF PROBLEMS. THE METHODS OF DESIGN COVERED INCLUDE SUCH TOPICS AS: DIVIDE-AND-CONQUER, THE GREEDY METHOD, DYNAMIC PROGRAMMING, SEARCH AND TRAVERSAL TECHNIQUES, AND BACKTRACKING.

**Prerequisite:** COSC 5321, MATH 2413 and 2305.

**COSC 6336 Database Management Systems****3 Semester Credit Hours (3 Lecture Hours)**

A STUDY OF CONTEMPORARY DATABASE MANAGEMENT CONCEPTS. PERFORMANCE (INDEXING, QUERY OPTIMIZATION, UPDATE OPTIMIZATION), CONCURRENCY, SECURITY AND RECOVERY ISSUES ARE DISCUSSED. ALSO INCLUDES THE STUDY OF FRONT-END ENVIRONMENTS THAT ACCESS THE DATABASE.

**Prerequisite:** COSC 5321.

**COSC 6337 Data Mining****3 Semester Credit Hours**

AN INTRODUCTION TO FUNDAMENTAL STRATEGIES AND METHODOLOGIES FOR DATA MINING. TOPICS INCLUDE DATA PREPROCESSING, MINING FREQUENT DATA PATTERNS, CLASSIFICATION, CLUSTERING, AND OUTLIER DETECTION.

**COSC 6338 Machine Learning****3 Semester Credit Hours (3 Lecture Hours)**

MACHINE LEARNING IS A SET OF TECHNIQUES THAT HAVE BEEN SUCCESSFULLY USED IN THE PAST FEW DECADES FOR DATA ANALYSIS, PROCESS AUTOMATION, FUNCTION OPTIMIZATION, MODEL BUILDING, AND MANY OTHERS. THESE TECHNIQUES HAVE BEEN EXPLORED IN A DIVERSITY OF FIELDS SUCH AS ROBOTICS, SELF-DRIVING CARS, BIG DATA, CONTROL OF AUTONOMOUS SYSTEMS, IMAGE ANALYSIS, OBJECT RECOGNITION, DATA MINING, BUSINESS, AND FINANCIAL FORECASTING, TRANSPORTATION SYSTEMS, ANTENNA DESIGN, MEDICAL CARE SYSTEMS, AND MANY OTHERS. ML IS A SUBDIVISION OF ARTIFICIAL INTELLIGENCE THAT GIVES MACHINES THE ABILITY TO LEARN AND ADAPT WITH DIFFERENT ACQUIRED KNOWLEDGE AND EXPERIENCE. IN THIS COURSE, A STUDENT WILL LEARN ABOUT STATE OF THE ART ON MACHINE LEARNING AND GET TO KNOW HOW THEY CAN CARRY OUT THESE EVOLVING LEARNING ALGORITHMS. ML ALGORITHMS ATTEMPT TO MIMIC HOW THE HUMAN BRAIN WORKS. WE PLAN TO DEVELOP MANY EXERCISES ON HOW THESE ML ALGORITHMS WORK IN PRACTICAL APPLICATIONS IN BOTH INDUSTRY AND BASIC SCIENCE. WE PLAN TO COVER TOPICS SUCH AS ARTIFICIAL NETWORK NETWORKS, FUZZY LOGIC, HYBRID SYSTEMS, SEARCH AND OPTIMIZATION, CLASSIFICATION, CLUSTERING AND DEEP LEARNING. STUDENTS WILL GAIN EXPERIENCES ON SOME PROGRAMMING TOOLS AND A VARIETY OF APPLICATIONS OF MACHINE LEARNING.

**COSC 6339 Deep Learning****3 Semester Credit Hours (3 Lecture Hours)**

THIS COURSE INTRODUCES CONCEPTS AND TECHNIQUES FOR DEEP LEARNING. THE OBJECTIVE OF THIS COURSE IS TO INTRODUCE THE FUNDAMENTAL THEORY AND APPLICATION OF DEEP LEARNING. PARTICULAR EMPHASIS WILL BE PLACED ON REGULARIZATION AND OPTIMIZATION OF DEEP LEARNING MODELS, CONVOLUTIONAL NETWORK, RECURRENT NEURAL NETWORKS, AUTOENCODERS AND GENERATIVE MODELS. IN ADDITION, THE STUDENTS WILL LEARN HOW TO APPLY THE METHODS TO SOLVE REAL-WORLD PROBLEMS IN SEVERAL AREAS INCLUDING REMOTE SENSING, GEOSPATIAL, AND MEDICAL APPLICATIONS AND DEVELOP THE INSIGHT NECESSARY TO USE THE TOOLS AND TECHNIQUES TO SOLVE ANY NEW PROBLEM.

**COSC 6340 Human-Computer Interaction****3 Semester Credit Hours (3 Lecture Hours)**

THIS GRADUATE COURSE INTRODUCES CONCEPTS AND TECHNIQUES FOR HUMAN COMPUTER INTERACTION. ATTENTION WILL BE PAID TO USING NON-TRADITIONAL INPUTS SUCH AS CAMERAS AND MICROPHONES. STUDENTS WILL LEARN TOOLS FOR USING THESE INPUTS TO CREATE INTERACTIONS WITH USERS.

**Prerequisite:** COSC 5331.

**COSC 6350 Advanced Topics in DBMS****3 Semester Credit Hours (3 Lecture Hours)**

THE STUDY OF EMERGING DATABASE TECHNOLOGIES. TOPICS ARE CHOSEN FROM DATA WAREHOUSING, DISTRIBUTED DATABASES, SPATIAL DATABASES AND WEB-BASED APPLICATIONS.

**Prerequisite:** COSC 6336.

**COSC 6351 Advanced Computer Architecture****3 Semester Credit Hours**

AN OVERVIEW OF COMPUTER ARCHITECTURE, WHICH STRESSES THE UNDERLYING DESIGN PRINCIPLES AND THE IMPACT OF THESE PRINCIPLES ON COMPUTER PERFORMANCE. GENERAL TOPICS INCLUDE DESIGN METHODOLOGY, PROCESSOR DESIGN, CONTROL DESIGN, MEMORY ORGANIZATION, SYSTEM ORGANIZATION, AND PARALLEL PROCESSING.

**Prerequisite:** COSC 5331.

**COSC 6352 Advanced Operating Systems****3 Semester Credit Hours (3 Lecture Hours)**

INTRODUCTION TO ADVANCED CONCEPTS IN OPERATING SYSTEMS AND DISTRIBUTED SYSTEMS. TOPICS INCLUDE DISTRIBUTED SYSTEM ARCHITECTURES, INTERPROCESS COMMUNICATION, DISTRIBUTED MUTUAL EXCLUSION, DISTRIBUTED SYNCHRONIZATION AND DEADLOCK, AGREEMENT PROTOCOLS, DISTRIBUTED SCHEDULING AND PROCESS MANAGEMENT, DISTRIBUTED SHARED MEMORY, DISTRIBUTED FILE SYSTEMS, MULTIPROCESSOR SYSTEM ARCHITECTURES AND OPERATING SYSTEMS, RECOVERY AND FAULT TOLERANCE.

**Prerequisite:** COSC 5331.

**COSC 6353 Compiler Design and Construction****3 Semester Credit Hours**

THIS COURSE INTRODUCES THE BASIC CONCEPTS AND MECHANISMS TRADITIONALLY EMPLOYED IN LANGUAGE TRANSLATORS, WITH EMPHASIS ON COMPILERS. TOPICS INCLUDE STRATEGIES FOR SYNTACTIC AND SEMANTIC ANALYSIS, TECHNIQUES OF CODE OPTIMIZATION AND APPROACHES TOWARD CODE GENERATION.

**Prerequisite:** MATH 2305.

**COSC 6354 Artificial Intelligence****3 Semester Credit Hours**

FUNDAMENTAL CONCEPTS AND TECHNIQUES FOR THE DESIGN OF COMPUTER-BASED, INTELLIGENT SYSTEMS. TOPICS INCLUDE: A BRIEF HISTORY, METHODS FOR KNOWLEDGE REPRESENTATION, HEURISTIC SEARCH TECHNIQUES, PROGRAMMING IN LISP OR PROLOG.

**Prerequisite:** COSC 5321 and MATH 2305.

**COSC 6355 Data Communications and Networking****3 Semester Credit Hours (3 Lecture Hours)**

AREAS STUDIED INCLUDE PRINCIPLES OF COMPUTER-BASED COMMUNICATION SYSTEMS, ANALYSIS AND DESIGN OF COMPUTER NETWORKS, AND DISTRIBUTED DATA PROCESSING.

**Prerequisite:** COSC 5331.

**COSC 6356 Theory of Computation****3 Semester Credit Hours**

AN INTRODUCTION TO THEORETICAL FOUNDATIONS OF MODERN COMPUTING. TOPICS INCLUDE FINITE STATE MACHINE CONCEPTS, FORMAL GRAMMARS, AND BASIC COMPUTABILITY CONCEPTS.

**Prerequisite:** COSC 5321 and MATH 2305.

**COSC 6357 Wireless Sensor Networks****3 Semester Credit Hours**

THIS IS A GRADUATE LEVEL COURSE ON WIRELESS SENSOR NETWORKS; ONE OF THE FASTEST DEVELOPING AREAS IN COMPUTER SCIENCE AND ENGINEERING. THE FOCUS OF THIS COURSE IS ON THE DESIGN OF OPTIMIZED ARCHITECTURES AND PROTOCOLS FOR SUCH UNIQUE NETWORKS. TOPICS INCLUDE THE DESIGN PRINCIPLES OF WIRELESS SENSOR NETWORKS, ENERGY MANAGEMENT, MAC PROTOCOLS, NAMING AND ADDRESSING, LOCALIZATION, ROUTING PROTOCOLS, APPLICATIONS OF WIRELESS SENSOR NETWORKS, AND ASSOCIATED CHALLENGES AND MEASURES.

**COSC 6360 Parallel Computing****3 Semester Credit Hours**

INTRODUCTION TO THE HARDWARE AND SOFTWARE ISSUES IN PARALLEL COMPUTING. TOPICS INCLUDE MOTIVATION AND HISTORY, PARALLEL ARCHITECTURES, PARALLEL ALGORITHM DESIGN, AND PARALLEL PERFORMANCE ANALYSIS. STUDENTS WILL BE INTRODUCED TO A VARIETY OF PARALLEL COMPUTING PARADIGMS INCLUDING MESSAGE PASSING SYSTEMS AND SHARED MEMORY SYSTEMS.

**Prerequisite:** COSC 5331.

**COSC 6361 Parallel Algorithms****3 Semester Credit Hours (3 Lecture Hours)**

INTRODUCES AND EVALUATES IMPORTANT MODELS OF PARALLEL AND DISTRIBUTED COMPUTATION. TOPICS INCLUDE A SELECTION OF PARALLEL ALGORITHMS FOR VARIOUS MODELS OF PARALLEL COMPUTATION, COMBINATIONAL CIRCUITS, PARALLEL PREFIX COMPUTATION, DIVIDE AND CONQUER, POINTER BASED DATA STRUCTURES, LINEAR ARRAYS, MESHES AND RELATED MODELS, AND HYPERCUBES.

**COSC 6362 Mobile Software Development****3 Semester Credit Hours**

SURVEY OF SOFTWARE DEVELOPMENT ON MOBILE PLATFORMS INCLUDING BOTH NATIVE AND CROSS-PLATFORM APPLICATIONS WITH TOPICS SUCH AS: PROTOTYPING, PROGRAMMING, TESTING, DEBUGGING, AND DEPLOYING. COVERAGE OF SOFTWARE LIFE CYCLE ON MOBILE PLATFORMS AND HOW MOBILE HARDWARE DIFFERS FROM TRADITIONAL COMPUTERS.

**Prerequisite:** COSC 5321.

**COSC 6365 Current Trends in Programming****3 Semester Credit Hours (3 Lecture Hours)**

THIS IS A SURVEY OF CURRENT TRENDS IN COMPUTER PROGRAMMING. THE FOCUS OF THIS COURSE IS ON THE DEVELOPMENT OF COMPUTER PROGRAMS UTILIZING THE LATEST TECHNOLOGIES AND PARADIGMS. TOPICS INCLUDE STATE-OF-THE-ART IN PROBLEM SOLVING AND SOFTWARE DEVELOPMENT, PROGRAMMING TECHNIQUES AND APPROACHES, PROGRAMMING LANGUAGES, DEVELOPMENT TOOLS AND ENVIRONMENTS, AND SOFTWARE DEPLOYMENT METHODS.

**Prerequisite:** COSC 5321.

**COSC 6370 Advanced Software Engineering****3 Semester Credit Hours**

AREAS STUDIED INCLUDE ENGINEERING PRINCIPLES AND THEIR APPLICATION TO THE DESIGN, DEVELOPMENT, TESTING, AND MAINTENANCE OF LARGE SOFTWARE SYSTEMS, TOOLS AND PROCESSES FOR MANAGING THE COMPLEXITIES INHERENT IN CREATING AND MAINTAINING LARGE SOFTWARE SYSTEMS.

**Prerequisite:** COSC 5321.

**COSC 6374 Computer Forensics****3 Semester Credit Hours**

THIS COURSE WILL INTRODUCE STUDENTS TO THE FUNDAMENTALS OF COMPUTER FORENSICS AND VARIOUS SOFTWARE TOOLS USED IN CYBER-CRIME ANALYSIS. STUDENTS WILL BE INTRODUCED TO ESTABLISHED METHODOLOGIES FOR CONDUCTING COMPUTER FORENSIC INVESTIGATIONS, AS WELL AS TO EMERGING INTERNATIONAL STANDARDS FOR COMPUTER FORENSICS. APPLICABLE LAWS AND REGULATIONS DEALING WITH COMPUTER FORENSIC ANALYSIS WILL ALSO BE DISCUSSED.

**COSC 6375 Information Assurance****3 Semester Credit Hours (3 Lecture Hours)**

AN INTRODUCTION TO INFORMATION SECURITY AND ASSURANCE. THIS COURSE COVERS THE BASIC NOTIONS OF CONFIDENTIALITY, INTEGRITY, AVAILABILITY, AUTHENTICATION MODELS, PROTECTION MODELS, SECURE PROGRAMMING, AUDIT, INTRUSION DETECTION AND RESPONSE, OPERATIONAL SECURITY ISSUES, PHYSICAL SECURITY ISSUES, PERSONNEL SECURITY, POLICY FORMATION AND ENFORCEMENT, ACCESS CONTROLS, INFORMATION FLOW, LEGAL AND SOCIAL ISSUES, CLASSIFICATION, TRUST MODELING, AND RISK ASSESSMENT.

**COSC 6376 Network Security****3 Semester Credit Hours**

THIS COURSE IS A STUDY OF NETWORKING BASICS AND SECURITY ESSENTIALS WITH RESPECT TO INFORMATION SERVICES PROVIDED OVER A COMPUTER NETWORK. THE COURSE COVERS THE TECHNICAL DETAILS OF SECURITY THREATS, VULNERABILITIES, ATTACKS, POLICIES, AND COUNTERMEASURES SUCH AS FIREWALLS, HONEYPOTS, INTRUSION DETECTION SYSTEMS, AND CRYPTOGRAPHIC ALGORITHMS FOR CONFIDENTIALITY AND AUTHENTICATION AND THE DEVELOPMENT OF STRATEGIES TO PROTECT INFORMATION SERVICES AND RESOURCES ACCESSIBLE ON A COMPUTER NETWORK.

**Prerequisite:** COSC 6375.

**COSC 6377 Applied Cryptography****3 Semester Credit Hours**

THIS COURSE INCLUDES AN INTRODUCTION TO CRYPTOGRAPHIC ALGORITHMS AND PROTOCOLS FOR ENCRYPTING INFORMATION SECURELY, TECHNIQUES FOR ANALYZING VULNERABILITIES OF PROTOCOLS, APPROACHES TO DIGITAL SIGNATURES AND INFORMATION DIGESTS, AND IMPLEMENTATION APPROACHES FOR THE MOST SIGNIFICANT CRYPTOGRAPHIC METHODOLOGIES.

**COSC 6379 Advanced Information Assurance****3 Semester Credit Hours**

THIS COURSE ENCOMPASSES A BROAD RANGE OF TOPICS INVOLVING INFORMATION SECURITY, COMMUNICATIONS SECURITY, NETWORK SECURITY, RISK ANALYSIS, OPERATIONAL SECURITY, HEALTH INFORMATION PRIVACY, CRIMINAL JUSTICE DIGITAL FORENSICS, HOMELAND SECURITY, THE HUMAN ELEMENT AND SOCIAL ENGINEERING, AND APPLICABLE NATIONAL AND INTERNATIONAL LAWS. AN IN-DEPTH INFORMATION ASSURANCE CAPSTONE PROJECT OR RESEARCH PAPER WILL BE REQUIRED OF EACH STUDENT TO SATISFY THE INFORMATION ASSURANCE GRADUATE OPTION REQUIREMENTS.

**Prerequisite:** COSC 6375.

**COSC 6380 Data Analytics****3 Semester Credit Hours (3 Lecture Hours)**

THIS COURSE WILL INTRODUCE STATE-OF-THE-ART TECHNIQUES TO PROCESS AND ANALYZE DIFFERENT TYPES OF DATA, GENERATE INSIGHTS AND KNOWLEDGE FROM DATA, AND MAKE DATA-BASED DECISIONS AND PREDICTIONS. REAL-WORLD EXAMPLES WILL BE USED TO FAMILIARIZE STUDENTS WITH THE THEORY AND APPLICATIONS. MAIN TOPICS INCLUDE DATA PREPROCESSING, PROBABILITY THEORY, TESTS OF HYPOTHESIS, AND VARIOUS DATA ANALYSIS TECHNIQUES (E.G., CLUSTERING, CLASSIFICATION, PREDICTION/FORECASTING, ETC.) FOR DIFFERENT TYPES OF DATA INCLUDING STATIC, TIME-SERIES, SPATIAL, AND SPATIOTEMPORAL.

**COSC 6393 Research Methods in Computer Science****3 Semester Credit Hours**

THIS COURSE PROVIDES STUDENTS WITH A RANGE OF EXPERIENCES IN CONDUCTING AND COMMUNICATING RESEARCH. STUDENTS WILL LEARN MAJOR RESEARCH METHODS AND TECHNIQUES. EXPERIENCES WILL BE GAINED IN ALL STAGES OF RESEARCH: REVIEWING LITERATURE, WRITING A PROPOSAL, DESIGNING AN APPROACH, AND REPORTING RESULTS. CRITICAL-READING/WRITING ASSIGNMENTS AND CLASS DISCUSSIONS ON STATE-OF-THE-ART RESEARCH IN COMPUTER SCIENCE WILL PROVIDE STUDENTS WITH MAJOR RESEARCH ASPECTS. SPRING

**COSC 6396 Directed Independent Study****3 Semester Credit Hours**

STUDY IN AREAS OF CURRENT INTEREST. (A MAXIMUM OF SIX HOURS MAY BE COUNTED TOWARD THE MS DEGREE.) FALL, SPRING, SUMMER.

**COSC 6590 Selected Topics****3 Semester Credit Hours (3 Lecture Hours)**

VARIABLE CONTENT STUDY OF SPECIFIC AREAS OF COMPUTER AND INFORMATION SYSTEMS. MAY BE REPEATED FOR CREDIT WHEN TOPICS VARY. OFFERED ON SUFFICIENT DEMAND.

**Geospatial Computer Science Courses****GSCS 6102 Graduate Seminar****1 Semester Credit Hour (1 Lecture Hour)**

ADVANCED TOPIC STUDY AND PRESENTATION BY STUDENTS, FACULTY, OR VISITING SCIENTISTS. MEETS ONE HOUR WEEKLY. MUST BE TAKEN THREE TIMES BY ALL GSCS PHD STUDENTS.

**GSCS 6302 Graduate Seminar****3 Semester Credit Hours (3 Lecture Hours)**

THIS IS A 3-CREDIT COURSE THAT IS INTENDED TO HELP FACILITATE THE DEVELOPMENT OF A STUDENT'S DISSERTATION RESEARCH IDEAS AND TO CONTRIBUTE TO THE STUDENT'S PROFESSIONAL DEVELOPMENT AS A DOCTORAL LEVEL RESEARCHER IN THE FIELD OF GEOSPATIAL COMPUTER SCIENCE. THE COURSE FOCUSES ON DEVELOPING PROFESSIONAL RESEARCH SKILLS TYPICALLY NOT PROVIDED IN FORMAL COURSEWORK SUCH AS METHODS FOR NOVEL RESEARCH, LITERATURE REVIEW, DEVELOPING A RESEARCH PROSPECTUS, PRESENTING SCIENTIFIC RESEARCH, RESEARCH ETHICS, PEER-REVIEW PROCESS, AND PROFESSIONAL SOCIETY ENGAGEMENT. AT THE OUTCOME, STUDENTS WILL HAVE A BETTER UNDERSTANDING OF THE RESEARCH PROCESS AND A FOUNDATION TO AID THEIR DEVELOPMENT AS A DOCTORAL STUDENT AND PROFESSIONAL SCIENTIFIC RESEARCHER.

**GSCS 6321 Geospatial Data Structures****3 Semester Credit Hours (3 Lecture Hours)**

THE REPRESENTATION OF SPATIAL DATA IS AN IMPORTANT ISSUE IN DIVERSE AREAS INCLUDING COMPUTER GRAPHICS, GEOGRAPHIC INFORMATION SYSTEMS (GIS), ROBOTICS, AND MANY OTHERS. CHOOSING AN APPROPRIATE REPRESENTATION IS A KEY TO FACILITATE OPERATIONS SUCH AS SPATIAL SEARCH. THIS COURSE WILL FOCUS ON REPRESENTATION OF POINT DATA AND OBJECT DATA, WHICH ARE THE IMPORTANT TYPES OF SPATIAL DATA. VARIOUS FUNDAMENTAL DATA STRUCTURES ON SPATIAL DATA, SUCH AS QUADTREES, KD-TREES, GRID STRUCTURES, KD-TREES, AND R-TREES WILL BE EXPLORED. THE USE OF THESE STRUCTURES TO ADDRESS SOME IMPORTANT PROBLEMS WILL ALSO BE COVERED.

**GSCS 6329 Scientific Visualization****3 Semester Credit Hours (3 Lecture Hours)**

THIS COURSE PRESENTS PRINCIPLES AND METHODS FOR VISUALIZING DATA RESULTING FROM MEASUREMENTS AND CALCULATIONS IN BOTH THE PHYSICAL SCIENCES AND THE LIFE SCIENCES. THE EMPHASIS IS ON USING 2D AND 3D COMPUTER GRAPHICS TO GARNER INSIGHT INTO MULTI-DIMENSIONAL DATA SETS FOR UNDERSTANDING AND SOLVING SCIENTIFIC PROBLEMS. TOPICS INCLUDE VISUALIZATION SOFTWARE AND TECHNIQUES, HUMAN VISION ATTRIBUTES AND LIMITATIONS, DATA ENCODING, DATA REPRESENTATION, VOLUME RENDERING, FLOW VISUALIZATION, AND INFORMATION VISUALIZATION.

**Prerequisite:** COSC 5327 and GSCS 6321.

**GSCS 6331 Advanced Geospatial Computing****3 Semester Credit Hours (3 Lecture Hours)**

SEMINAR IN READING AND CRITICAL EVALUATION OF ACADEMIC LITERATURE IN THE FIELD OF AND FIELDS RELATING TO GEOSPATIAL COMPUTING. STUDENT WILL DESIGN, IMPLEMENT, AND EVALUATE AN ADVANCED, CONTEMPORARY GEOSPATIAL COMPUTING TECHNOLOGY TO SOLVE A GEOSPATIAL PROBLEM.

**GSCS 6344 Ubiquitous Positioning****3 Semester Credit Hours (3 Lecture Hours)**

THE AIM OF THIS COURSE IS TO INTRODUCE THE PRINCIPLE OF POSITIONING INDOORS/OUTDOORS USING SENSORS AND SHORT-RANGE RADIO FREQUENCY SIGNALS IN SMARTPHONES. THESE SENSORS WILL INCLUDE A GNSS RECEIVER, AN ACCELEROMETER, A GYROSCOPE, A MAGNETOMETER, A BAROMETER, AND A CAMERA, WHY SHORT-RANGE RF SIGNALS WILL INCLUDE WIFI AND BLUETOOTH SIGNALS. THE COURSE WILL CONCENTRATE ON VARIOUS POSITIONING ALGORITHMS FOR FUSING SENSOR MEASUREMENTS AND RF SIGNAL MEASUREMENTS.

**Prerequisite:** GSCS 5321.

**GSCS 6390 Special Topics****3 Semester Credit Hours (3 Lecture Hours)**

VARIABLE CONTENT STUDY OF SPECIFIC AREAS OF GEOSPATIAL COMPUTING SCIENCE. MAY BE REPEATED FOR CREDIT WHEN TOPICS VARY. OFFERED ON SUFFICIENT DEMAND.

**GSCS 6996 Research****1-9 Semester Credit Hours**

INDEPENDENT RESEARCH CONDUCTED UNDER SUPERVISION OF AN ADVISOR. OPEN TO GEOSPATIAL COMPUTING SCIENCE STUDENTS WHO HAVE NOT YET PASSED THE QUALIFYING EXAM AND WITH CONSENT OF THEIR GRADUATE ADVISOR. THE COURSE IS GRADED WITH AN S OR U, AND MAY BE REPEATED.

**GSCS 6998 Dissertation Research****1-9 Semester Credit Hours**

RESEARCH RELATED TO PHD DISSERTATION. OPEN ONLY TO DEGREE CANDIDATES HAVING PASSED THE QUALIFYING EXAM IN GEOSPATIAL COMPUTING SCIENCE WITH CONSENT OF THEIR GRADUATE ADVISOR. THE COURSE IS GRADED WITH AN S OR U, AND MAY BE REPEATED.

**GSCS 6999 Dissertation Defense****1-9 Semester Credit Hours**

OPEN ONLY TO DEGREE CANDIDATES IN GEOSPATIAL COMPUTING SCIENCE WITH CONSENT OF THEIR GRADUATE ADVISOR. STUDENTS SHOULD ENROLL IN THIS COURSE DURING THEIR LAST SEMESTER OF THE GSCS PHD PROGRAM. TO SUCCESSFULLY COMPLETE THIS COURSE THE STUDENT MUST PASS THE DISSERTATION DEFENSE AS WELL AS HAVE A FINAL COPY OF THE DISSERTATION SIGNED BY THE FULL GRADUATE COMMITTEE AND APPROVED FOR BINDING AND DISTRIBUTION. A GRADE OF CREDIT/NO CREDIT WILL BE ASSIGNED FOR THE CLASS WITH THE POSSIBILITY TO ASSIGN THE GRADE OF IP OR IN PROGRESS. IF A GRADE OF IP IS ASSIGNED, THE COURSE MUST BE REPEATED THE FOLLOWING SEMESTER(S) UNTIL THE COURSE IS PASSED.