Graduate Studies in Computing and Technology

Fortune Mhlanga
Dean; Director of Graduate Studies in Computing and Technology
Graduate Studies in Computing and Technology

• Master of Science in Data Science
• Master of Science in Information Technology
• Master of Science in Software Engineering
• Certificate of Graduate Studies in Data Science
• Certificate of Graduate Studies in Information Technology
• Certificate of Graduate Studies in Software Engineering

Fortune Mhlanga, Dean, College of Computing and Technology; Director of Graduate Studies in Computing and Technology

The College of Computing and Technology offers innovative and uniquely multi-disciplinary programs that prepare graduates for entrepreneurial, technical and executive leadership positions within our industry, and further advanced degrees.

Admission Policies and Procedures

Applicants to graduate programs must submit the following:

1. Application Form. Each applicant must complete an application form. The application form is available at lipscomb.edu/admissions/graduate then click on “Apply by Program” to complete the online application.

2. Application Fee. Each application should be accompanied by a $50 nonrefundable application fee ($75 for international students).

3. Standardized exam score. Each applicant must submit scores from the Graduate Record Examination. For more information on the GRE, visit www.ets.org/ and click on GRE. Applicants taking the GRE test should contact the program office for current requirements. Students who have already earned a master’s level degree may not need to complete the GRE standardized test.

4. Eligibility. Each applicant must submit documentation verifying course work or demonstrated competency in information technology concepts and terminology, statistics and computer literacy and must satisfy one of the following:

• Hold an advanced degree (master’s or doctorate) in a relevant area of study.
• Hold a bachelor’s degree in a relevant area of study, with five years of related work experience.
• Hold a bachelor’s degree in a relevant area of study and submit GRE scores with application, if less than five years of related work experience.

5. References. Two letters of reference are required as follows: one from a college or university administrator or professor and one from a professional supervisor/employer, or personal reference.

6. Official Transcript(s). Each applicant must submit an official transcript, showing degree conferral when appropriate, from all schools attended.

7. Health Form. Each applicant must submit a completed health form signed by a health care provider. (To print a copy of the health form, visit www.lipscomb.edu/healthcenter/forms.)
8. **FERPA**. The Family Educational Rights and Privacy Act affords students certain rights of access to educational records; even if you are independent of your parents, you must submit this form prior to enrollment.

9. **Resume**. A resume detailing the applicant’s work and academic experience is required.

10. **Personal Statement**. Each applicant must submit an expanded goals statement concerning the applicant’s interest in and application of the program’s curriculum to expected career progression.

11. **TOEFL**. The Test of English as a Foreign Language is required for international students. (See section titled International Students for more information.)

All application items should be submitted to the College of Computing and Technology office no later than 30 days before the beginning of the semester or term in which the student plans to enroll. Items should be submitted online or mailed to: Graduate Studies in Computing and Technology, Lipscomb University, One University Park Drive, Nashville TN 37204-3951.

**Transfer of Courses**

Although all graduate credit hours may be transferred from another accredited institution, a maximum of six hours will be counted toward a master in the College of Computing and Technology. The program director or appropriate faculty member of the graduate program will evaluate the course(s) being proposed for transfer and make a determination of suitability. No course with a grade below a “B” will be considered for transfer.

**Documentation**

Students are required to provide satisfactory documentation of personal identification for off-site learning experiences required in many programs of graduate study at Lipscomb University. Failure to provide proper credentials will result in failure to complete the desired course of study. For complete policy, see section entitled Required Documentation for Off-Site Learning Experiences in the opening section of this catalog.

**Student Classifications**

Students are admitted to graduate courses in one of five categories:

1. **Graduate Student**: one who has satisfied all admissions requirements. (Average of 2.75 on undergraduate work, GRE acceptable scores.) A student with an incomplete admission file will be accepted to the program at the discretion of the program director but will be placed on an academic hold which will prevent registration for the following semester. Once the proper admissions documents have been received, the hold will be removed and the student will be allowed to register for the following semester.

2. **Conditionally Admitted Student**: one who has been admitted conditionally, at the discretion of the program director, without satisfying all admission requirements. Students admitted with the following criteria may be required to complete a minimum of nine hours of graduate work with a grade of “B” or above.
   a. From an unaccredited school or with a substandard GPA or GRE/MAT score.
   b. A transfer student with a graduate GPA between 2.50 and 2.99. The transfer student must be in good standing at the previous institution attended.
   c. As a student who has not completed a bachelor’s degree program. The transfer student must be in good standing at the previous institution attended.

3. **Non-Degree Student**: one who has been admitted to graduate studies and has met all admission requirements except GPA or GRE. The student may take up to nine semester hours for graduate credit. Those hours may be applied toward a master’s degree if the student makes a grade of “B” or better in the courses taken for credit and if all admission requirements (GPA and entrance test score) are met and the student is formally admitted to a graduate program as a degree-seeking student.

4. **Visiting Student**: one who is currently enrolled as a student in good standing at the post-bachelor’s level at another graduate school, wishes to take courses at Lipscomb and desires to have transcript evidence of course work done at Lipscomb provided for the school of primary enrollment.

5. **Probationary Student**: one who has been readmitted to a graduate program following academic suspension from the program.

Admission to a program does not imply admission to candidacy for the master’s degree. Only those students who meet the requirements for “graduate student” described above are eligible for candidacy.
Academic Policies

Course Load
A student enrolled for nine hours is considered a full-time student. A student enrolled for six hours is considered a half-time student. A student enrolled for less than six hours is considered a part-time student. No student will be permitted to enroll for more than 15 hours per semester without special approval from the director of the graduate program.

Academic Standing
1. **Good Academic Standing:** To remain in good academic standing, the College of Computing and Technology student must maintain a cumulative 3.00 GPA and a 3.00 GPA on the most recent 12 semester hours of work.

2. **Probation:** Should the student’s cumulative graduate GPA fall below 3.00, he or she will be placed on academic probation. A student on academic probation will not be allowed to enroll for more than six hours during any term the probation applies.

   The probationary student is required to achieve a 3.00 cumulative GPA by the time the student has completed the next nine hours of course work. A course(s) may be repeated to achieve the requisite GPA. If the requisite GPA is attained, the academic probation status will be removed.

3. **Suspension:** If the requisite GPA is not attained, the student will be suspended from graduate studies at Lipscomb for the following semester, after which the student may apply for readmission. The student may be required to appear before the graduate committee.

   Failing grades will provide no credit toward the degree but will be included in figuring scholarship level, unless replaced with a higher grade by repeating the course(s). A 3.00 GPA must be maintained to be eligible for financial assistance.

4. **Appeals:** Appeals to suspension decisions should be made in writing to the vice provost for academic development and graduate studies. Appeals must be received no later than 4:30 p.m. on the Monday of the week before classes begin for the term during which the student wishes to be readmitted.

Degree Completion Requirements

Residency
No period of formal residency is required for a degree in a master’s program.

Statute of Limitations
All requirements for a degree in the College of Computing and Technology must be completed within a five-year period from the time of initial matriculation.

Candidacy
Admission to a program does not imply admission to candidacy for the master’s degree. During the course of pursuing a degree in the School of Computing and Informatics, the student must be admitted to “candidacy.” For admission to candidacy the student must satisfy the following:

1. Complete all required undergraduate deficiencies if admitted on condition.

2. Complete at least twelve hours of graduate work.

3. Maintain a 3.00 GPA on all courses taken toward the requirements for the degree with no incomplete grades.

4. File a degree plan and application for candidacy in the graduate program office which meet all requirements and are approved by the administrator of the graduate program and the dean of the college. The degree plan must be filed during the second semester of graduate work in the program.

   After admission to candidacy and approval of the degree plan, any changes in the degree plan must be approved by the administrator of the graduate program and the dean of the college. The application for candidacy must be filed before the beginning of the student’s last semester in the program. No student will be allowed to graduate in the same semester in which the application for candidacy is filed.

Minimum GPA
The minimum cumulative grade-point average for all graduate education programs is 3.00 for all graduate courses taken for graduate credit while pursuing the degree. No grade below a “C” is acceptable. Such grades will not apply toward degree completion.
Graduation
Students must register for GN 999X the semester in which all course work will be completed for graduation. Students who do not file their intent to graduate form in the registrar’s office by the end of the first week of their last semester may be delayed in graduating.

Graduate students receiving degrees are hooded during the May and December commencement exercises.

Appeals
Any exceptions to the above stated requirements would require approval via the appeal process established by the graduate academic leadership team.

Financial Information
Tuition and Fees for 2015-16

Basic charges* per semester:
Tuition per semester hour of graduate credit .... $1,226 (includes all textbooks)
Tuition to audit without credit .. 50% of regular tuition

Special Fees
Application fee........ $50 ($75 for international students)
Application for Graduation..........................$195
Late registration ......................................$195
Printed refund check fee.............................$25
Returned check fee ....................................$30
Thesis fee (includes printing and binding) ....... $50
TouchNet (monthly payment) .........................$60
fee per semester
Withdrawal fee.............................................$195

*Effective May 1, 2015

Course Designations
MSDS – Data Science
ISEC – Information Security
MSIT – Information Technology
MITM- Information Technology Management
MSSE – Software Engineering

Master of Science in Data Science (30 hours)

While the advent of information technology brings tremendous opportunities for industry, business and government agencies, it also brings with it increasing complexities of the digital economy and challenges to enterprises and to individual executives and managers. Today, the informatics analyst, who deals with big data to find insights into new and emerging types of data and content, is the sought-after professional.

The Master of Science in Data Science degree program is designed to equip professionals with best-practice knowledge and current methodologies to make their businesses more agile as they acquire skills to aggregate and analyze disparate types of data and to recognize patterns and trends within that data. It builds on the experience of participants and also emphasizes the development of communication and presentation skills in a team-based data-driven economy. Class participation is crucial as students often learn as much from each other as from the faculty and course materials. The curriculum encompasses all important aspects of data science, including:

- Information structures
- Statistical analysis and decision modeling
- Research methods in informatics
- Big data management and analytics
- Predictive analytics and data mining
- Information ethics, law and policy

Completion of the program requires 30 graduate credits (10 courses). To provide a common background in informatics and analytics, 8 core courses are required of all students. In addition to the core courses, students will choose an emphasis area within the program. Emphasis areas include but are not limited to:

- Health emphasis: health services delivery, management, planning and consumption
- Business emphasis: finance, business strategy, and marketing

Emphasis areas may be expanded or adjusted based on student interest and at the program director’s discretion. The degree culminates with a comprehensive real-life, industry-type practicum, comprising six of the 30 credits, oriented toward the student’s selected emphasis area.
• The ideal student has a passion for understanding how data and data-driven thinking can transform all aspects of contemporary life.

• Faculty are not only leaders in their field but also work with individual students to offer personalized attention not often found at other institutions.

• The two-night per week course delivery format is designed to meet the needs of working professionals.

• Highly technical, relevant and hands-on training provides the ability to effectively participate in all phases of the data science process.

• The cohort program includes course work being delivered in as short as 12 months.

Minimum Credits
The Master of Science in Data Science requires 30 semester hours. This requirement does not include hours accumulated to satisfy academic deficiencies.

Required Courses (30 hours)
Phase I: Research and Design
MSDS 5013 Principles of Data Science (3)
MSDS 5023 Information Structures (3)
MSDS 5043 Principles of Statistical Analysis and Decision Modeling (3)
MSDS 5053 Research Methods in Informatics (3)
MSDS 5143 Practicum I (3)

Phase II: Implementation and Analytics
MSDS 5153 Big Data Management and Analytics (3)
MSDS 5163 Data Mining and Analysis (3)
MSDS 5213 Predictive Analytics and Data Mining (3)
MSDS 5223 Case Studies in Data Science (3)
MSDS 5243 Practicum II (3)

Certificate of Graduate Studies in Data Science (15 hours)
Required Courses
MSDS 5013 Principles of Data Science (3)
MSDS 5023 Information Structures (3)
MSDS 5043 Principles of Statistical Analysis and Decision Modeling (3)

MSDS 5053 Research Methods (3)
MSDS 5223 Case Studies in Data Science (3)

Master of Science in Data Science Course Descriptions
MSDS 5013 Principles of Data Science (3)
Principles of data science including theories, concepts analytics process models, data analytics process models, data analytics life cycle and development of data science teams. Foundations of descriptive statistics and probability, Big data (characteristics and applications), analytical methods of data mining algorithms, matrix algebra, graph theory and relational databases. Different perspectives from which data is used, the different terminology used when referring to them and a number of representation and manipulation methods.

MSDS 5023 Information Structures (3)
The concepts and structures used to analyze, store, manage and present information and navigation. Topics include information analysis and organization methods, XML and metadata concepts and application. Treatment, in particular, structured, semi-structured and unstructured data models.

MSDS 5043 Principles of Statistical Analysis and Decision Modeling (3)
Principles of statistical and probabilistic analysis with focus on practical decisions and risk using quantitative models. Topics include overview of probability, descriptive and graphical statistical methods, sampling and sampling distributions, estimation, hypothesis testing, analysis of variance, study design and linear regression, decision modeling and simulation, and in-depth discussion on application of statistical techniques to the processing and interpretation of data from various industries and disciplines.
MSDS 5053  Research Methods (3)
The research process investigating information needs, creation, organization, flow, retrieval and use. Stages include: research definition, questions, objectives, data collection and management, data analysis and data interpretation. Techniques include: observation, interviews, questionnaires and transaction-log analysis.

MSDS 5143  Practicum I (3)
The data science practicum is intended to give participants an experience working as a member of a data science team conducting a data analytics research and design phase of a real-world project. The students will be asked to serve in team roles, hold oral research and design reviews, and prepare documentation appropriate to the project. Informatics and Analytics Practicum I is the first of two required MSDS Practicum courses.

MSDS 5153  Big Data Management and Analytics (3)

MSDS 5163  Data Mining and Analysis (3)
Computational techniques for analysis of large, complex datasets, covering fundamental aspects as well as modern data mining and analysis techniques. Hands-on experience with data mining software.

MSDS 5213  Predictive Analytics and Data Mining (3)
Investigation of predictive modeling using valuable prospective intelligence hidden within large volumes of data. In-depth study of data mining techniques at a tactical level and understanding of how various methods and tools apply to different kinds of data intensive problems.

MSDS 5223  Case Studies in Data Science (3)
Deep and critical examination of contemporary data science implementations within a student selected emphasis area. Focus on understanding factors necessary to develop an effective data science program within that particular context.

MSDS 5243  Practicum II (3)
This course is a continuation of MSDS 5143 (Practicum I) and focuses on the implementation and analytics phase of the real-world project. In addition, students will participate in the design and implementation reviews of other teams in the class.

Master of Science in Information Technology (30 hours)
While the advent of information technology brings tremendous opportunities for industry, it also brings with it increasing complexities of the digital economy and challenges to those people seeking to get ahead in this field. Today, the information technology manager is the sought-after professional. Yet, technology managers are expected to have both a broad background and specialized knowledge. If you have been working in IT as an individual contributor you may not have the up-to-date education necessary to enable you to maximize your career opportunities. New graduates may find that they need more in-depth study to find the right career path. The Master of Science in Information Technology degree program is designed to equip all three individuals with best-practice knowledge and current methodologies needed for them to succeed in the workplace. Students collaborate within the classroom environment to research and present technology driven solutions to real-world business problems.

The curriculum comprises five core courses, plus a practicum, covering foundations of modern information technology and four courses in each of four concentration areas.

The four concentration tracks are:
- Data Science
- Information Technology Management
- Information Security
- Software Engineering
Completion of the program requires 30 graduate credits (10 courses). To provide a common background in information technology, five core courses are required of all students. In addition to the core courses, students will choose a concentration track within the program by taking four courses in an emphasis area. The core program culminates with a comprehensive real-life industry type practicum, oriented toward the student’s area of interest.

**Minimum Credits**
The M.S. in Information Technology requires 30 semester hours, exclusive of hours accumulated to satisfy academic deficiencies.

**Core Courses (18 hours):**
MSIT 5113  Network Systems and Technologies  
MSIT 5133  Database Systems and Technologies  
MSIT 5153  Web Development Technologies  
MSIT 5173  IT Law and Policy  
MSIT 5213  IT System Integration and Architecture  
MSIT 6113  Practicum (in chosen track)

**MS Information Technology Concentrations**

**Concentration Courses (12 hours):**
In addition to the courses listed above, students will choose a four-course (twelve-hour) concentration in one of the following areas:
- Data Science
- Information Security
- Information Technology Management
- Software Engineering

**Track I courses: Data Science (12 hours)**
MSDS 5013  Principles of Data Science (3)  
MSDS 5043  Statistical Analysis and Decision Modeling (3)  
MSDS 5053  Research Methods (3)  
MSDS 5163  Data Mining and Analysis (3)

**Track II courses: Information Technology Management (12 hours)**
MITM 5003  Principles of Information Technology Management (3)  
MITM 5013  Telecommunications Network Management (3)  
MITM 5203  IT Project Management (3)

**Track III courses: Information Security (12 hours)**
ISEC 5113  Introduction to Information Security (3)  
ISEC 5123  Risk Assessment and Mitigation Planning (3)  
ISEC 5193  Systems and Application Security and Planning (3)  
ISEC 5223  Business Continuity and Disaster Recovery Planning (3)

**Track IV courses: Software Engineering (12 hours)**
MSSE 5023  Perspectives on Software Engineering: Requirements Engineering and Modeling (3)  
MSSE 5033  Object-Oriented Analysis and Design (3)  
MSSE 5043  Software Architecture and Design (3)  
MSSE 5203  Software Quality Assurance and Testing (3)

**Certificate of Graduate Studies in Information Technology**
(15 hours)

**Required Courses**
MSIT 5113  Network Systems and Technologies  
MSIT 5133  Database Systems and Technologies  
MSIT 5153  Web Development Technologies  
MSIT 5173  IT Law and Policy  
MSIT 5213  IT System Integration and Architecture

**Master of Science in Information Technology Course Descriptions**

**ISEC 5113  Introduction to Information Security (3)**  
This course is designed to communicate the fundamental concepts of risk based information security planning and introduce to the student the importance of securing all aspects of the organization. This includes everything from the physical plant, to human resources, to databases, networks and all communications that concern the

**MSIT 5113  Networking Systems and Technologies (3)**  
This course will review contemporary topics in network systems and
technologies to enable the student to design and plan network solutions to meet business objectives. The course will enable students to have a broad understanding of technologies and the factors that need to be considered in designing networks for practical applications. Topics to be considered include areas such as: software defined networks, wireless, data center networks, routing and management, security and anonymity, performance and user behavior and experience.

**MSIT 5133 Database Systems and Technologies (3)**
Principles of database systems and technologies, including their application to business systems. This course will cover modern database technologies, factors influencing their successful implementation and contemporary application of those systems to business applications. The course will start with a review of traditional RDMS and their application so data warehouses and OLTP applications. It will then cover newer approaches such as NoSQL, graph and array databases and Hadoop. The course will present trends in modern database technology, including column stores vs. row stores, main memory databases and high availability systems. Factors influencing successful database system implementation such as performance, availability, security and privacy will be discussed. Finally, application of modern database technology to current business applications will be presented, including data storage needs of modern web applications, large data problems and documented-oriented data stores.

**MSIT 5153 Web Development Technologies (3)**
This course is designed to give the student insights into the principles, protocols and practices associated with development of modern web applications. Topics covered include: historical perspective and protocols; basics of http and html; XML applications; web services, including REST and SOAP; web servers and browsers; active browser pages, from JavaScript to AJAX; approaches to web application development; examples, including Ruby on Rails, Struts and JSTL; server technologies; and future trends. Examples of real world web architectures and the problem they solve will be used to illustrate the principles. Principles of application performance engineering, security evaluation and usability will be discussed as part of the context in which the application will be used. The overall presentation will be suitable for both developers and architects.

**MSIT 5173 IT Law and Policy (3)**
Introduction to laws and policies that influence the production, distribution and use of information technologies. Focus will be on issues of privacy, online speech, intellectual property, the creative commons, computer crime and governance.

**MSIT 5213 IT System Integration and Architecture (3)**
Businesses today are critically interested in integrating applications and data to improve revenue, increase efficiency and provide competitive advantage. Cloud services have provided an exciting new tool which IT managers can use for this purpose. This course looks at principles and practices around using SaaS, IaaS and PaaS cloud technologies to integrate applications and business processes. Web APIs will be covered, along with data exchange formats such as JSON and XML. High level architectures will be illustrated covering cloud-cloud integration and cloud to core integration. Students will also learn how to manage key cloud integration metrics such as security, stability and cost. The course will look at commercial cloud integration frameworks, such as Boomi, CastIron, MuleSoft and TIBCO CloudBus, as well as business application such as Amazon, Uber and Paypal. Students will create their own integrated cloud application using commercially based services, and demonstrate to the class.

**MSIT 6113 Practicum (in chosen track) (3)**
The Practicum to the Information Technology master’s degree is the student’s choice between a research
paper and a project. The project or paper will be a topic of the student’s choosing but it must be approved by the assigned faculty advisor prior to starting. The subject matter will be from the student’s chosen track concentration. The Practicum must be of a certain level of import and depth as to demonstrate the student’s complete understanding of the concepts and procedures of the chosen subject matter.

MITM 5203 IT Project Management (3)
Evaluation of methods to manage the development and implementation of a system so that it meets all aspects of stake-holder needs. Discussions of how to initiate, analyze, develop, implement and maintain systems projects, and of how to keep a project timeline, budget and attain the highest possible results from an information setting.

MITM 5023 Data and Knowledge Management (3)
Data management: modeling, using, securing and sharing organizational data resources. Business intelligence: applications and technologies for gathering, storing, analyzing and providing access to help enterprise users make better business decisions. Knowledge management: effective deployment of technology, organizational practices and processes to increase an organization’s return on its knowledge capital.

MITM 5003 Principles of Information Technology Management (3)
Introduction to the basic concepts of information technology management—its structure, standards, security requirements and definitions, including the broad range of skills necessary for successful management of information technology at the enterprise level.

MITM 5013 Telecommunications Network Management (3)
In-depth study of telecommunications network management technology systems. Architecture, functions, methods and protocols necessary to design modern telecommunications network management systems. Network management standards such as Telecommunications Management Network and Simple Network Management Protocol. Basic network management concepts, protocols and methods with real-world examples used to address these. Management aspects of planning and controlling/decision making for telecommunication

ISEC 5113  Introduction to Information Security (3)
This course is designed to communicate the fundamental concepts of risk based information security planning and introduce to the student the importance of securing all aspects of the organization. This includes everything from the physical plant, to human resources, to databases, networks and all communications that concern the transmission of data/information.

ISEC 5123  Risk Assessment & Mitigation Planning (3)
This course will address how risks are fully identified and understood in an organization. From this foundation mitigation strategies can be developed. Risk assessment addresses both the process of identifying vulnerabilities and threats as well as the probabilities of their occurrence and potential impact.

ISEC 5193  Systems & Application Security and Planning (3)
Protection and verification procedures needed for all systems and applications are reviewed in this course. Controls are needed for information technology systems to ensure confidentiality, integrity and non-repudiation of an organization’s sensitive information. Security of applications and the importance of making them secure along with the systems is also discussed.

ISEC 5223  Business Continuity and Disaster Recovery Planning (3)
This course addresses specifically the maintenance of information and the processes of how to continue in business in the face of a data loss and how to plan for the recovery in the event of such a loss.

Master of Science in Software Engineering (30 hours)
The Master of Science in Software Engineering degree program is designed to equip professionals with a strong foundation of theory, best-practice knowledge, current methodologies, and emerging technologies and their applications, in software engineering. It builds on the experience of participants and also emphasizes the development of communication and presentation skills in a team-based software development environment. Class participation is crucial as students often learn as much from each other as from the faculty and course materials. The curriculum encompasses all important aspects of software engineering, including:

- Software engineering processes
- Requirements engineering and modeling
- Software architecture and design
- Software construction, evaluation and administration
- Software maintenance, evolution and re-engineering
- Software configuration management
- Software project planning and management
- Software quality assurance and testing

Completion of the program requires 30 graduate credits (10 courses). The degree culminates with a comprehensive real-life, industry-type practicum, comprising three of the 30 credits, oriented toward the student’s domain of interest.

The Graduate Certificate in software engineering will be awarded after completing 15 graduate credits (five courses) focusing on survey of requirements engineering and modeling, object-oriented analysis and design, software architecture and design, database engineering and administration and software quality assurance. Students that successfully complete the graduate certificate in software engineering can matriculate into the Master of Science in software engineering program by fulfilling the remaining requirements for the software engineering graduate program.
Minimum Entry Requirements
Entry requirements for the software engineering graduate program are high and the process is quite competitive. The ability to perform graduate-level work, a solid undergraduate background in computer science or related disciplines, software development maturity and industry experience are several factors considered for admission. Because the ability to understand and communicate in English is essential, we require international applicants to take the TOEFL examination, or its equivalent.

Minimum Credits
The M.S. in software engineering requires 30 semester hours, exclusive of hours accumulated to satisfy academic deficiencies.

Required Courses (30 hours):
MSSE 5023  Perspectives on Software Engineering: Requirements Engineering and Modeling
MSSE 5033  Object-Oriented Analysis and Design
MSSE 5043  Software Architecture and Design
MSSE 5123  Database Modeling and Design
MSSE 5203  Software Quality Assurance and Testing
MSSE 5313  Graphical User Interface Design and Evaluation
MSSE 5323  Software Maintenance, Evolution and Re-Engineering
MSSE 5413  Software Development for Embedded and Real-time Systems
MSSE 5423  Software Project Planning and Management
MSSE 6113  Software Engineering Practicum

Certificate of Graduate Studies in Software Engineering
(15 hours)

Required Courses:
MSSE 5023  Perspectives on Software Engineering: Requirements Engineering and Modeling
MSSE 5033  Object-Oriented Analysis and Design
MSSE 5043  Software Architecture and Design
MSSE 5113  Agile Software Development
MSSE 5123  Database Modeling and Design
MSSE 5203  Software Quality Assurance and Testing

Master of Science in Software Engineering
Course Descriptions

MSSE 5023  Perspectives on Software Engineering: Requirements Engineering and Modeling (3)
Perspectives on software engineering processes. In-depth study of engineering requirements and an overview of various modeling techniques applicable to requirements analysis and specification, including UML and formal methods.

MSSE 5033  Object-Oriented Analysis and Design (3)
In-depth understanding of object oriented approaches to software development, in particular to the analysis and design phases of the software life cycle. Modern software engineering practices including object-oriented analysis and design, unified modeling language, design patterns, and iterative and agile software development processes.

MSSE 5043  Software Architecture and Design (3)
The process of constructing software, including the structural views of software components, and their characteristics and interrelationships, at a high level of abstraction. The course also covers the design principles that govern the purpose, structure, development and evolution of software components.

MSSE 5123  Database Modeling and Design (3)
Application of software engineering approaches in the strategy, analysis, design, implementation, verification and validation phases of large scaled database design. Data modeling concepts using ER and UML notation. Use of data modeling concepts in the database design process. Theory of database design through the normalization process and the functional equivalence with conceptual modeling. The “impedance mismatch” problem. Logical database design issues in business intelligence—data warehousing, OLAP for decision support systems and data mining.
MSSE 5203  **Software Quality Assurance and Testing (3)**  
Fundamental concepts of software quality assurance and testing.  
Functional testing. GUI based testing tools. Control flow based test adequacy criteria. Data flow based test adequacy criteria. White box based testing tools. Mutation testing and testing tools. Relationship between test adequacy criteria. Finite state machine based testing. Static and dynamic program slicing for testing and debugging. Software quality and reliability. Testing management techniques and support tools; team-oriented project used methods, techniques and practices learned.

MSSE 5313  **Graphical User Interface Design and Evaluation (3)**  
Theory, design, evaluation and development process for interactive application interfaces. User- and task centered approaches to design. Variety of interface evaluation techniques, and an overview of current interface trends including Web interfaces and information visualization. Conduct of case study for a large design and evaluation project whose topics include: human capabilities and limitations, the interface design and engineering process, prototyping, issues in interface construction, interface evaluation, and current topics such as data visualization, World Wide Web and small UI device interface issues, and social and collaborative computing.

MSSE 5323  **Software Maintenance, Evolution and Re-Engineering (3)**  
Principles and techniques of software maintenance. Impact of software development process on software justifiability, maintainability, evolvability, and planning of release cycles. Use of very high-level languages and dependencies for forward engineering and reverse engineering. Achievements, pitfalls and trends in software reuse, reverse engineering and re-engineering.

MSSE 5413  **Software Development for Embedded and Real-time Systems (3)**  
Software development requirements and understanding of system architecture, modeling, scheduling, and low-level hardware control of sensors and/or motors. Appreciation of the complicated development of the often safety-critical and embedded real-time systems. General concepts and techniques related to real-time and embedded systems, including concurrent programming, real-time scheduling, low-level hardware control, system modeling and verification, resource access, and multiprocessor systems. Introduction to the basic concepts and processes of system safety, how verification and fault-tolerance fit within this umbrella, and the role of regulatory agencies and certification standards.

MSSE 5423  **Software Project Planning and Management (3)**  

MSSE 6113  **Software Engineering Practicum (3)**  
The software engineering practicum is intended to give participants an experience working as a member of a software engineering team developing a product for which the schedule is fixed and the scope is appropriate for the number of people working on the team. The students will be asked to serve in team roles (teams of 4-5), hold oral design reviews and prepare documentation appropriate to their product. In addition, students will participate in the design reviews of other teams in the class.
College of Computing & Technology Core Faculty

Full-time faculty is supplemented with adjunct faculty members who are experts in their fields.

Eddy C. Borera, B.S. (Abilene Christian University), M.S., Ph.D. (Texas Tech University), Assistant Professor of Computer Science

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