

UNIVERSITY COLLEGE

University College offers the following programs:

- Master of Science Degree in Artificial Intelligence
- Dual Doctor of Medicine and Master of Science Degree in Artificial Intelligence
- Master of Arts Degree in Multidisciplinary Studies
- Master of Science Degree in Multidisciplinary Studies
- Doctor of Philosophy Degree in Translational Science
- Graduate Certificate in Data Engineering
- Graduate Certificate in Data Science
- Graduate Certificate in National Security Studies
- Graduate Certificate in Teaching
- M.S. in Artificial Intelligence (p. 1)
- Dual M.D./M.S. in Artificial Intelligence (p. 3)
- M.A. in Multidisciplinary Studies (p. 5)
- M.S. in Multidisciplinary Studies (p. 5)
- Ph.D. in Translational Science (p. 6)

Master of Science Degree in Artificial Intelligence

The Master of Science degree in Artificial Intelligence program is designed to train and equip graduate students in core AI concepts that will fortify their career prospects in AI or related fields. The program comprises three concentrations—1) Analytics, 2) Computer Science, and 3) Intelligent and Autonomous Systems—which provide a broad spectrum of courses for graduate students to specialize in sub-areas within the AI field. Through these concentrations, the program trains graduate students in the design, development, use, and deployment of AI technologies. Curated AI courses provide students with a repertoire of AI skills and tools for effectively solving problems in a specific domain and extend the knowledge to advance their respective disciplines. The program also offers a multidisciplinary environment that supports industry-readiness in innovative AI sub-fields. A thesis option is offered for students who want the opportunity to obtain expertise in research and who may be interested in pursuing a doctoral degree in AI-related fields. A non-thesis option is available for students who prefer a practical applications-oriented degree.

Program Admission Requirements

In addition to the University-wide graduate admission requirements, admission decisions will be based on a combination of the following:

- A bachelor's degree in engineering, sciences, mathematics, or in related fields for exceptional candidates.
- A Statement of Purpose.
- A current résumé.
- Two letters of recommendation.
- A minimum grade point average of 3.0 in the last 60 semester credit hours of coursework.
- A minimum score of 79 on the Test of English as a Foreign Language (TOEFL) iBT or 6.5 on the International English Language Testing System (IELTS), for students whose native language is not English.

Submission of the Graduate Record Examination (GRE) is optional. A student who does not qualify for unconditional admission may be admitted on a conditional basis as determined by the AI Core Committee.

Degree Requirements

The M.S. in AI program is offered with both Thesis and Non-Thesis options. A minimum of 30 semester credit hours are required to complete the program, including 9 credit hours of core courses, 15 credit hours of concentration-required courses, and 6 credit hours of elective courses for the Non-Thesis Option or 6 credit hours of thesis/capstone project. Thesis and Non-Thesis students can take courses outside of the suggested courses below with approval from the Graduate Advisor of Record (GAR). All approved courses that count towards the degree should be listed on the students Program of Study. All incoming students are required to enroll in the core courses to achieve a common understanding and knowledge of AI foundations. The enrollment for the graduate thesis must be in consultation with the supervising professor and receive approval from the Program Director.

Thesis Option

The degree requires 30 semester credit hours, including 24 technical course credits and 6 thesis credits identified as Master's Thesis in the specific concentration. Students should take 9 semester credit hours of common core courses in the first two semesters. 15 semester credit hours of required courses must be taken within the concentration area to satisfy the depth requirement. No more than 3 semester credit hours of independent study should be included. Depending on the concentration choice, 3 to 6 semester credit hours may be taken from other concentration courses with the approval of the Core Committee. The distribution of required courses is shown below.

Code	Title	Credit Hours
A. Required Core Courses		9
CS 5233	Artificial Intelligence	
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Intro to Machine Learning)	
STA 5093	Introduction to Statistical Inference	
B. Prescribed Electives (a set of five courses in the chosen concentration) *		15
Analytics Concentration		
DA 6213	Data-Driven Decision Making and Design	
DA 6223	Data Analytics Tools and Techniques	
DA 6233	Data Analytics Visualization and Communication	
DA 6813	Data Analytics Applications	
IS 6713	Data Foundations	
IS 6733	Deep Learning on Cloud Platforms	
IS 6973	Special Problems	
STA 6003	Statistical Methods in Research and Practice I	
STA 6033	SAS Programming and Data Management	
STA 6233	R Programming for Data Science	
STA 6443	Statistical Modeling	
STA 6543	Predictive Modeling	
CS/EE	Elective	
Computer Science Concentration		

Section 1: Select three to five courses from the following:

CS 5243	Computer Vision
CS 5463	Topics in Computer Science (Topic: Autonomous Driving)
CS 5463	Topics in Computer Science (Topic: Robotics)
CS 5463	Topics in Computer Science (Topic: Adversarial AI)
CS 5463	Topics in Computer Science (Topic: Parallel and Distributed Machine Learning)
CS 5483	Topics in Data Science (Topic: Brain Inspired AI)
CS 5593	Multi-Agent Systems
CS 5813	Cognitive Neuroscience Inspired Machine Learning
CS 5823	Trust, Confidence and Explainability in Artificial Intelligence
CS 6263	Natural Language Processing
CS 6283	Deep Learning
CS 6313	Deep Reinforcement Learning
CS 6383	Quantum Machine Learning

Section 2: Select up to two courses from the following:

CS 5513	Computer Architecture
CS 5523	Operating Systems
CS 5633	Analysis of Algorithms
CS 5463	Topics in Computer Science (Topic: Developing AI Tools for K-12)

Intelligent and Autonomous Systems Concentration

Additional electives may be chosen from other AI concentrations.

EE 5103	Engineering Programming
EE 5143	Linear Systems and Control
EE 5153	Random Signals and Noise
EE 5243	Special Topics in Control (Topic: Reinforcement Learning)
EE 5243	Special Topics in Control (Topic: Optimal Control and Applications)
EE 5243	Special Topics in Control (Topic: Optimization and Control of Cyber Physical Systems)
EE 5243	Special Topics in Control (Topic: Computational Intelligence)
EE 5243	Special Topics in Control (Topic: Network Multi-Agent System)
EE 5243	Special Topics in Control (Topic: Advanced Robotics and AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Brain Inspired AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: AI in Engineering)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Natural Language Processing w/Deep Learning)
or IS 6973	Special Problems

EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Computational Intelligence in Data Analysis)
or STA 6443	Statistical Modeling
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Statistical Inference)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Bioinformatics)
EE 6363	Advanced Topics in Signal Processing (Topic: Deep Learning)

C. Thesis 6

A minimum of 6 semester credit hours are needed. Students must enroll in the Thesis section belonging to their concentration.

CS 6983	Master's Thesis
EE 6983	Master's Thesis
STA 6983	Master's Thesis

Total Credit Hours 30

* Additional elective courses can be approved by the Graduate Studies Committee.

Non-Thesis Option

The degree requires 30 semester credit hours of technical course credits. Students should take 9 semester credit hours of common core courses in the first two semesters. 15 semester credit hours of required courses must be taken within the concentration area to satisfy the depth requirement. No more than 3 semester credit hours of independent study should be included. Depending on the concentration choice, 3 to 6 semester credit hours may be taken from other concentration courses with approval of the Core Committee. An additional 6 semester credit hours of elective courses must be taken from the concentration or outside the concentration. The distribution of required courses is given below.

Code	Title	Credit Hours
------	-------	--------------

A. Required Core Courses 9

CS 5233	Artificial Intelligence
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Top: Intro to Machine Learning)
STA 5093	Introduction to Statistical Inference

B. Prescribed Electives (a set of five courses in the chosen concentration) * 15

Analytics Concentration

IS 6713	Data Foundations
IS 6733	Deep Learning on Cloud Platforms
IS 6973	Special Problems
STA 6033	SAS Programming and Data Management
STA 6233	R Programming for Data Science
STA 6443	Statistical Modeling
STA 6543	Predictive Modeling
STA 6003	Statistical Methods in Research and Practice I
DA 6213	Data-Driven Decision Making and Design

DA 6223	Data Analytics Tools and Techniques
DA 6233	Data Analytics Visualization and Communication
DA 6813	Data Analytics Applications
CS/EE	Elective

Computer Science Concentration

Section 1: Select three to five courses from the following:

CS 5243	Computer Vision
CS 5483	Topics in Data Science (Topic: Brain Inspired AI)
CS 5593	Multi-Agent Systems
CS 5813	Cognitive Neuroscience Inspired Machine Learning
CS 5823	Trust, Confidence and Explainability in Artificial Intelligence
CS 6263	Natural Language Processing
CS 6283	Deep Learning
CS 6313	Deep Reinforcement Learning
CS 6383	Quantum Machine Learning
CS 5463	Topics in Computer Science (Topic: Autonomous Driving)
CS 5463	Topics in Computer Science (Topic: Robotics)
CS 5463	Topics in Computer Science (Topic: Adversarial AI)
CS 5463	Topics in Computer Science (Topic: Parallel and Distributed Machine Learning)

Section 2: Select up to two courses from the following:

CS 5513	Computer Architecture
CS 5523	Operating Systems
CS 5633	Analysis of Algorithms

Intelligent and Autonomous Systems Concentration

Additional electives may be chosen from other concentrations.

EE 5103	Engineering Programming
EE 5143	Linear Systems and Control
EE 5153	Random Signals and Noise
EE 5243	Special Topics in Control (Topic: Reinforcement Learning)
EE 5243	Special Topics in Control (Topic: Optimal Control and Applications)
EE 5243	Special Topics in Control (Topic: Optimization & Control of Cyber Physical Systems)
EE 5243	Special Topics in Control (Topic: Computational Intelligence)
EE 5243	Special Topics in Control (Topic: Network Multi-Agent System)
EE 5243	Special Topics in Control (Topic: Advanced Robotics and AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Brain Inspired AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: AI in Engineering)

EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Natural Language Processing w/Deep Learning)
or IS 6973	Special Problems
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Computational Intelligence in Data Analysis)
or STA 6443	Statistical Modeling
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Statistical Inference)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Bioinformatics)
EE 6363	Advanced Topics in Signal Processing (Topic: Deep Learning)

C. Non-Thesis: 6 hours of electives from inside or outside concentration with advisor approval. 6

Total Credit Hours 30

* Additional elective courses can be approved by the Graduate Studies Committee.

Dual Doctor of Medicine and Master of Science Degree in Artificial Intelligence

The Doctor of Medicine (M.D.) and Master of Science (M.S.) in Artificial Intelligence (AI) Dual Degree is offered by UT Health San Antonio Long School of Medicine and UTSA. This M.D./M.S. in AI is designed to prepare students for the next generation of healthcare advances by providing comprehensive training in applied artificial intelligence. Armed with this training, graduates can become future leaders in research, education, academia, industry, and healthcare administration, shaping the future of healthcare for all. Students will apply to the M.S. in AI degree and select one of three concentrations: #1) Analytics, 2) Computer Science, and 3) Intelligent and Autonomous Systems, which provide a broad spectrum of courses for graduate students to specialize in sub-areas within the AI field.

Program Admission Requirements

In addition to the University-wide graduate admission requirements, admission decisions will be based on a combination of the following:

- Current enrollment in the Undergraduate Medical Education program at UT Health San Antonio
- A minimum grade point average of 3.0 (on a 4.0 scale) in the last 60 semester credit hours of coursework.
- For students whose native language is not English, a minimum score of 79 on the Test of English as a Foreign Language (TOEFL) iBT or 6.5 on the International English Language Testing System (IELTS) is required.

Submission of the Graduate Record Examination (GRE) is optional. A student who does not qualify for unconditional admission may be admitted on a conditional basis as determined by the AI Core Committee.

Degree Requirements

The M.D./M.S. in AI program is offered as a non-thesis degree program. A minimum of 30 semester credit hours are required to complete the program, including 9 credit hours of core courses, 15 credit hours of concentration required courses, and 6 credit hours of capstone project courses. All incoming students are required to enroll in the core courses to achieve a common understanding and knowledge of AI foundations. Additional courses offered at UT Health can be found in the School of Medicine Catalog (<http://catalog.uthscsa.edu/schoolofmedicine/md/>).

Code	Title	Credit Hours
A. Required Core Courses		9
CS 5233	Artificial Intelligence	
EE 5263	Advanced Topics in Signal Processing and Machine Learning	
STA 5093	Introduction to Statistical Inference	
B. Prescribed Electives (a set of five courses in the chosen concentration)*		15
Analytics Concentration		
DA 6213	Data-Driven Decision Making and Design	
DA 6223	Data Analytics Tools and Techniques	
DA 6233	Data Analytics Visualization and Communication	
DA 6813	Data Analytics Applications	
IS 6713	Data Foundations	
IS 6733	Deep Learning on Cloud Platforms	
IS 6973	Special Problems	
STA 6003	Statistical Methods in Research and Practice I	
STA 6033	SAS Programming and Data Management	
STA 6233	R Programming for Data Science	
STA 6443	Statistical Modeling	
STA 6543	Predictive Modeling	
CS/EE Elective		
Computer Science Concentration		
Section 1: Select three to five courses from the following:		
CS 5243	Computer Vision	
CS 5463	Topics in Computer Science (Topic: Autonomous Driving)	
CS 5463	Topics in Computer Science (Topic: Robotics)	
CS 5463	Topics in Computer Science (Topic: Adversarial AI)	
CS 5463	Topics in Computer Science (Topic: Parallel and Distributed Machine Learning)	
CS 5483	Topics in Data Science (Topic: Brain Inspired AI)	
CS 5593	Multi-Agent Systems	
CS 5813	Cognitive Neuroscience Inspired Machine Learning	
CS 5823	Trust, Confidence and Explainability in Artificial Intelligence	
CS 6263	Natural Language Processing	
CS 6283	Deep Learning	

CS 6313	Deep Reinforcement Learning
CS 6383	Quantum Machine Learning
Section 2: Select up to two courses from the following:	
CS 5513	Computer Architecture
CS 5523	Operating Systems
CS 5633	Analysis of Algorithms
Intelligent and Autonomous Systems Concentration	
Additional electives may be chosen from other AI concentrations.	
EE 5103	Engineering Programming
EE 5143	Linear Systems and Control
EE 5153	Random Signals and Noise
EE 5243	Special Topics in Control (Topic: Reinforcement Learning)
EE 5243	Special Topics in Control (Topic: Optimal Control and Applications)
EE 5243	Special Topics in Control (Topic: Optimization and Control of Cyber Physical Systems)
EE 5243	Special Topics in Control (Topic: Computational Intelligence)
EE 5243	Special Topics in Control (Topic: Network Multi-Agent System)
EE 5243	Special Topics in Control (Topic: Advanced Robotics and AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Brain Inspired AI)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: AI in Engineering)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Natural Language Processing w/Deep Learning)
or IS 6973	Special Problems
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Computational Intelligence in Data Analysis)
or STA 6443	Statistical Modeling
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Statistical Inference)
EE 5263	Advanced Topics in Signal Processing and Machine Learning (Topic: Bioinformatics)
EE 6363	Advanced Topics in Signal Processing (Topic: Deep Learning)

C. Capstone 6

Students who earn a GPA of 3.0 or higher in both Capstone courses (INTD 4011 Machine Learning with AI I and INTD 4012 Machine Learning with AI II) will satisfy the comprehensive examination requirement for the M.D./M.S. in AI dual degree. Students must enroll in the Capstone Courses at UT Health.

Total Credit Hours 30

* Additional elective courses may be approved by the Graduate Studies Committee.

Master of Arts Degree in Multidisciplinary Studies

The Master of Arts (M.A.) in Multidisciplinary Studies (MDST) is a professional degree that can enhance career path development and help students develop specific marketable skills needed to advance their careers. One additional benefit to the multidisciplinary nature of the M.A. in MDST is that it can help eliminate the barriers encountered with traditional M.A. programs that restrict students to one area of expertise. This stackable certificate program prepares students with fundamental and advanced knowledge and skills for the workforce.

MDST students will design a degree plan that builds on personal interests, academic strengths, and career opportunities. The degree plan pairs graduate certificates in two academic disciplines that enrich students' marketable skills. At least one of the graduate certificates must be outside the science field to qualify for the M.A. degree. Otherwise, please see the information below on the Master of Science in Multidisciplinary Studies (https://catalog.utsa.edu/graduate/translationalscience/#ms_mds) program.

The M.A. in Multidisciplinary Studies is also offered in a 100 percent online format.

Program Admission Requirements

In addition to the University-wide graduate admission requirements, admission decisions will be based on a combination of the following:

- A bachelor's degree in the fields related to the certificate programs of interest.
- A minimum grade point average of 3.0 in the last 60 semester credit hours of coursework.
- A minimum score of 79 on the Test of English as a Foreign Language (TOEFL) iBT or 6.5 on the International English Language Testing System (IELTS), for students whose native language is not English.
- A current résumé with employment or other experience.

Submission of the Graduate Record Examination (GRE) is optional. A student who does not qualify for unconditional admission may be admitted on a conditional basis as determined by the Admissions Committee.

Degree Requirements

To earn the M.A. in Multidisciplinary Studies degree, students must complete 30 semester credit hours. Students should complete two certificate programs as prescribed. No more than 3 semester credit hours of independent study should be included. Depending on the selected certificate pairing, 3 to 6 semester credit hours of graduate-level courses that align with the certificates may be taken as approved by the Graduate Advisor of Record. To satisfy the comprehensive examination requirement, candidates for the M.A. in Multidisciplinary Studies will be required to complete a course designated from one of the concentrations selected (certificate areas) or MDS 6833 with a grade of "B" (3.0) or better.

Master of Science Degree in Multidisciplinary Studies

The Master of Science (M.S.) in Multidisciplinary Studies (MDST) is a professional degree that prepares students with a diverse academic background—including science, technology, engineering, mathematics, health, and social science—to combine their knowledge into one career, including consulting, systems engineering, information systems management, and data analyst. This professional degree program is designed to prepare graduate students across multiple disciplines with fundamental science, health, and engineering knowledge and skills for the workforce.

MDST students will design a degree plan that builds on personal interests, academic strengths, and career opportunities. The degree plan pairs graduate certificates in two academic disciplines that enrich students' marketable skills. Both of the graduate certificates must be within the science field to qualify for the M.S. degree. Otherwise, please see the information above on the Master of Arts in Multidisciplinary Studies (https://catalog.utsa.edu/graduate/translationalscience/#ma_mds) program.

The M.S. in Multidisciplinary Studies is also offered in a 100 percent online format.

Program Admission Requirements

In addition to the University-wide graduate admission requirements, admission decisions will be based on a combination of the following:

- A bachelor's degree in the fields related to the certificate programs of interest.
- A minimum grade point average of 3.0 in the last 60 semester credit hours of coursework.
- A minimum score of 79 on the Test of English as a Foreign Language (TOEFL) iBT or 6.5 on the International English Language Testing System (IELTS), for students whose native language is not English.
- A current résumé with employment or other experience.

Submission of the Graduate Record Examination (GRE) is optional. A student who does not qualify for unconditional admission may be admitted on a conditional basis as determined by the Admissions Committee.

Degree Requirements

To earn the M.S. in Multidisciplinary Studies degree, students must complete 30 semester credit hours. Students should complete two certificate programs as prescribed. No more than 3 semester credit hours of independent study should be included. Depending on the selected certificate pairing, 3 to 6 semester credit hours of graduate-level courses that align with the certificates may be taken as approved by the Graduate Advisor of Record. To satisfy the comprehensive examination requirement, candidates for the M.S. in Multidisciplinary Studies will be required to complete a course designated from one of the concentrations selected (certificate areas) or MDS 6833 with a grade of "B" (3.0) or better.

Doctor of Philosophy Degree in Translational Science

The Doctor of Philosophy (Ph.D.) degree in Translational Science (TS) at The University of Texas at San Antonio (UTSA) is offered through a joint graduate program with The University of Texas Health Science Center at San Antonio (UTHSCSA) and The University of Texas at Austin (UT Austin). The program is designed to use the existing resources and expertise in specific key areas of each university to offer a strong, diverse, and competitive Translational Science Ph.D. program. The TS Ph.D. will prepare the next generation of scientists to lead the multidisciplinary biomedical research teams of the future in increasingly complex research environments. Areas of research emphasis/excellence include, but are not limited to: Hispanic health, military medicine, comprehensive cancer research, aging and longevity, obesity and diabetes/metabolic syndrome, infectious diseases, addiction, and targeted drug delivery. The Ph.D. degree in Translational Science will be awarded to candidates who have displayed an in-depth understanding of the subject matter and demonstrated the ability to make an original contribution to knowledge in their specialized area of study.

The regulations for this degree comply with the general University regulations (refer to Student Policies, General Academic Regulations, and the Graduate Catalog, Doctoral Degree Regulations).

Admission Requirements

The TS Ph.D. is an advanced scientific research doctoral program. In addition to satisfying the University-wide graduate admission requirements (refer to Student Policies, Admission Policies), the following admission requirements will be applied to all applicants:

1. Completion of, or enrollment in, an advanced professional degree (e.g., M.D., D.O., D.D.S., M.S.N., Pharm.D.), completion of a master's or doctoral degree, preferably in a health-related, science, public health, or social science discipline, or enrollment as an M.D./Ph.D. student with successful completion of the two-year pre-clinical curriculum. Enrollment/graduation must be from an accredited college or university in the United States, or proof of equivalent training at a foreign institution, with a minimum grade point average of 3.0 in the professional and/or graduate work.
2. A valid TOEFL/ IELTS/ Duolingo score less than two years old at the time of submitted application is required. Official Test of English as a Foreign Language (TOEFL) iBT score, with a score of at least an 84; a score of 7.0 on the Academic Examination of the International English Language Testing System (IELTS); or a score of 115 for the Duolingo English Test for applicants whose native language is not English. Applicants whose scores fall below the minimum requirement will be further assessed for English comprehension skills. TOEFL may be waived for applicants whose post-secondary education was conducted with English as the language of instruction. ECFMG certified physicians will also be granted a TOEFL waiver. NOTE: Consistent with Texas Education Code, Section 51.842(b), an applicant's standardized test scores, when used to make admission or scholarship decisions, will be compared with scores of other applicants from similar socioeconomic backgrounds, to the extent such information is available.
3. Official documentation of the Graduate Record Examination (GRE), or an equivalent, is not required. However, should an applicant submit the GRE score, it will be considered along with the other admission criteria, but will not be used as the sole criterion when making admission decisions. Scores for GRE tests taken more than five years

prior to the date of application are not valid and should not be part of the application.

4. A personal statement (1–3 pages) that describes the applicant's past training and experience, future career goals and objectives, scientific research interest, and how the TS Ph.D. program will prepare them to achieve their stated research interest and career goals. The Personal Statement should include, but is not limited to:
 - A statement of the applicant's background and purpose for applying to the TS Ph.D. program.
 - Applicant's interest in and commitment to a translational science career.
 - Applicant's potential to develop into a successful scientist, as evidenced by research training/experience, prior publications, etc.
 - Research interest and its applicability to the TS Ph.D. program.
 - Identification of a potential Supervising Professor, if applicable.
 - Career goals and how the TS Ph.D. program will contribute to their attainment.
5. Recommendation Forms and letters of recommendation from three (3) faculty or other individuals who are familiar with and can provide information about the applicant's academic, research, and/or professional abilities and performance, in addition to the applicant's potential to succeed in a doctoral program and develop into an independent research investigator.
6. A current curriculum vitae.
7. A copy of the applicant's U.S. medical or other health professional license or certificate, if applicable.

Full-time students accepted for the program are eligible to apply for financial support in the form of competitive teaching assistantships, research assistantships, or research fellowships.

Applications must be submitted online (<https://uthscsa.edu/biomedical-sciences/what-know-you-apply/>). A complete application includes the application form, official transcripts, letters of recommendation, curriculum vitae, a copy of the health professions license/certificate (if applicable), and a personal statement. TOEFL, IELTS, or Duolingo scores, or waiver request, are required for applicants whose native language is not English. Incomplete applications will not be considered. The TS Committee on Graduate Studies (TS COGS), with members from each of the participating institutions, is responsible for reviewing applications for admission and selecting the most qualified applicants. Authorization of Security Background and Sanction check is required before a recommendation for admission consideration.

Degree Requirements

The degree requires a minimum of 72 semester credit hours beyond the master's or professional degree. The curriculum consists of core courses (24 semester credit hours), elective courses (18 semester credit hours), and a minimum of 30 semester credit hours of combined research and dissertation hours that are required for the completion of the TS Ph.D. degree. The Translational Science Ph.D. Program also offers a Data Science track defined as 12 semester credit hours, which are counted toward the 72 hours of graduate coursework required to complete the program. Students will work with a graduate advisor or the supervising professor to complete an individualized degree plan that will meet the student's research interests and goals. Using the individualized degree plan as a guide, courses may be taken at any participating institution with the written approval of the graduate advisor or supervising professor.

Any grade lower than a "B" in a graduate course will not count toward the minimum number of required semester credit hours. Students

matriculating with a master's degree may use up to 30 semester credit hours toward the degree, provided the courses are comparable to the core and elective courses and are approved by the TS Committee on Graduate Studies.

Advancement to Candidacy

TS Ph.D. students will advance to candidacy after completing and receiving an overall grade of "Pass" on each of their written and oral qualifying examinations. The Qualifying Examination will be administered before the start of dissertation research, and admission to candidacy will be contingent on receiving an overall grade of "Pass" on each component. Methods for administration of the qualifying exam will be written and oral. The exam will be comprehensive and will include questions covering:

- Knowledge/Information gained through the translational science coursework, and
- The basic knowledge required for the chosen area of research.

The format of the exam and composition of the Qualifying Examination Committee (QEC) will be determined by the TS COGS. Additional criteria may be set by the home institution, such as approval by an institution-specific committee, such as a Graduate Studies Committee (GSC), in addition to the TS COGS. At a minimum, each QEC will have representatives from two UT institutions and at least one graduate faculty member from a discipline outside the student's main area of study. The QEC will administer the qualifying exam at a set date and time, will utilize the results as the basis for evaluating the student's performance, and will report its judgment of performance to the TS COGS and the home institution's committee, if applicable.

The qualifying exam is composed of two parts:

1. **Written Exam on Course Content:** The written exam is a series of assignments designed to test the student's background in translational science and their ability to apply this knowledge to research and core didactic coursework. Students will have up to three weeks to complete the written portion of the qualifying exam:
 - a. The exam will be a take-home exam, and a three week period will be allowed for completion.
 - b. The exam will include one question per domain in the TS Ph.D. curriculum (eight questions total). The instructor for the course taken by the student to fulfill the course requirement for each domain will write the question.
 - c. The response to each question will be limited to 1,000 words. Literature citations are not part of the word count. Students who wish to add exhibits or other addenda must get prior approval from the instructor/question writer.
 - d. Responses will be typed and submitted electronically as a PDF file.
 - e. Students will not be released from lab or class responsibilities while they are completing this portion of the qualifying exam.
 - f. The Written Exam will be scheduled at a time mutually agreed upon by the student, the Supervising Professor, and the participating instructors/question writers and graders.
2. **Dissertation Proposal:** The Dissertation Proposal will consist of the Written Dissertation Proposal and the Oral Exam on the Dissertation Proposal. The Dissertation Committee, chaired by the Supervising Professor, will be responsible for evaluating and grading these components.
 - a. **Written Dissertation Proposal:** The student will prepare a written research proposal that will be the basis for the dissertation

research. The Dissertation Proposal will be submitted to the Dissertation Committee at a time mutually agreed upon by the student and the Dissertation Committee, but at least two weeks prior to the scheduling of the Oral Exam.

- b. **Oral Exam on Dissertation Research Proposal:** The oral exam will consist of a presentation of the Dissertation Proposal (a preliminary explanation of the proposed research project which will be defended at the completion of the dissertation) and should include background, methods, and proposed analyses. The relevance of the proposed research to Translational Science must also be addressed. QE Assessment Forms are available online. It is recommended that students review the assessment forms to ensure that all criteria are met. The Dissertation Committee, through questioning, will engage the candidate in a discussion of the proposed research to delineate the strengths and weaknesses of the approach. The oral exam will follow the submission of the written Dissertation Proposal and will be scheduled at a time mutually agreed upon by the student and the Dissertation Committee.

Students who do not pass the qualifying exam will have their performance reviewed by the QEC. If the qualifying exam is not passed, the QEC may recommend:

1. Specific remediation in areas that require further study, including taking further coursework
2. The student be allowed to retake the qualifying exam or section(s) of the exam, as appropriate
3. The student be dismissed from the graduate program

Students who retake the qualifying exam and who do not pass it on the second attempt will be dismissed from the TS Ph.D. program. Any student wishing to transfer to a master's program will be responsible for identifying an appropriate program and applying.

Dissertation

Candidates must demonstrate their ability to conduct independent research by completing and defending an original dissertation. The research topic is determined by the student in consultation with the supervising professor and the Dissertation Committee. A student must choose a Dissertation Committee by the end of the second semester of study or within 90 days following the student's admission to candidacy. The Dissertation Committee will include at least four members, but may have additional members if required by the Graduate School of the student's home institution. Minimum Dissertation Committee requirements are:

1. The Supervising Professor, who will act as the Chair
2. Graduate faculty from the TS Ph.D. program from the student's home institution
3. Graduate faculty from the TS Ph.D. program from a second institution participating in the joint degree program
4. A member from an outside institution who is not part of the TS Ph.D. program and is an expert in the student's dissertation field

Approval of the Dissertation Committee and the completed dissertation will follow the guidelines established by the Graduate School of the student's home institution. Refer to the TS PhD Student Handbook (<https://iims.uthsca.edu/education/education/tsphd/student-resources/>) for further information on dissertation requirements.

Final Oral Examination (Defense of Dissertation)

Completion of the dissertation will require a satisfactory final oral examination, as evaluated and approved by the Dissertation Committee. The final oral examination will cover aspects of the dissertation, information derived from the general field of the dissertation research, and other parts of the student's individualized curriculum as determined by the Dissertation Committee. The relevance of the dissertation to the field of Translational Science will also be evaluated. Satisfactory completion of the final oral examination will be evaluated based on whether the student has:

1. Completed all work assigned by the Dissertation Committee
2. Passed all examinations, including the final oral examination
3. Completed the minimum requirements as outlined in the student's individualized curriculum plan
4. Completed a dissertation that meets the criteria outlined above for independent investigation and contribution to the scientific discipline
5. Submitted an approved abstract for publication

Following a thorough review of the completion of these requirements, the Dissertation Committee will sign the approval sheets and provide an official recommendation to the TS COGS regarding the award of the doctoral degree.

If the dissertation is considered meritorious by a majority vote of the TS COGS, the TS COGS will accept the Dissertation Committee's approval and then inform the Graduate School of the student's home institution. Awarding of the degree is based on the approval of the Dissertation Committee, approved by the Dean. The UTSA Dean of the Graduate School certifies the completion of all University-wide requirements. The TS COGS will also inform the Graduate Schools of the other UT components.

Program of Study

The TS Ph.D. curriculum is designed to meet requirements and display expertise in eight educational domains:

1. Translational Science
2. Responsible Conduct
3. Research Design and Analysis
4. Team Science and Leadership
5. Multi-level Cultural Proficiency
6. Scientific Communication
7. Business of Translational Science
8. Evidence-based Implementation and Policy

Refer to the UT Health Catalog (<http://catalog.uthscsa.edu/biomedicalsciences/translationalscience/phd/#admissionsrequirements>) and TS PhD Student Handbook (<https://iims.uthscsa.edu/education/education/tsphd/student-resources/>) (<https://www.uthscsa.edu/academics/biomedical-sciences/programs/translational-science-phd/>) for further information on program requirements.

Code	Title	Credit Hours
A. Core Curriculum (24 semester credit hours required):		24
A minimum of 24 semester credit hours must be taken in courses with content specific to the eight educational domains for the TS Ph.D. program. For some domains, only one course is available. For others, equivalent courses are offered on multiple campuses—UTSA, UTHSCSA, UTCOP (UT Austin College of Pharmacy), and UTSPH (UT School of Public Health San Antonio Regional Campus). The TS COGS will evaluate each university's curriculum annually and may approve courses not included on this list. The courses selected to meet the core course requirements must be approved by the academic advisor/supervising professor prior to enrollment.		
B. Electives (18 semester hours required):		18
2 hours of a Directed Elective (Topics in Translational Science course). Students must register for Topics in TS for two semesters to meet the Directed Elective requirement and they may register up to three additional times for elective credit.		
16 hours of Prescribed Electives		
These can be selected from many graduate-level courses offered at any of the four participating institutions. The courses selected should contribute to the student's research and career needs and must be approved as part of the student's individualized degree plan by the academic advisor/supervising professor prior to enrollment.		
C. A minimum of 30 hours combined of Doctoral Research and Dissertation hours are required.		30
Total Credit Hours		72
<ul style="list-style-type: none"> • Graduate Certificate in Data Engineering (p. 8) • Graduate Certificate in Data Science (p. 9) • Graduate Certificate in National Security Studies (p. 9) • Graduate Certificate in Teaching (p. 10) 		

Graduate Certificate in Data Engineering

The Data Engineering Certificate program is designed to meet the growing demand for skilled data engineers in various industries. It aims to equip students with the essential knowledge and hands-on skills needed to excel in the field of data engineering, focusing on areas such as data ingestion, storage, transformation, and pipeline architecture. The program integrates both theoretical and practical components to ensure students gain a comprehensive understanding of data engineering principles and applications.

Admissions Requirements

- Applicant should have a Bachelor of Science (B.S.) degree or be in their junior year of a B.S. degree in closely related fields in Engineering, Computer Science, Statistics, Cyber Security, Math, Information Systems, and Physics with a minimum GPA of 3.00 in relevant courses, such as programming, algorithms, etc.
- Applicants without a B.S. or degrees unrelated to the mentioned fields may be eligible based on relevant work experience (subject to review).
- Applicants should acquire or already possess coding skills, particularly in Python programming, through UTSA courses or online platforms. DataCamp (https://www.datacamp.com/blog/how-to-get-10-years-of-free-datacamp-if-youre-a-teacher-or-student/?utm_source=linkedin&utm_medium=organic_social&utm_campaign=230820_1-blog_2-mix_3-all_4-na_5-na_6-classrooms_7-le_8-ogsl-li_9-na_10-bau_11-na) is a free online resource for those who are interested.

- Applicants should submit a Resume and a Statement of Purpose with their Application.

Certificate Program Requirements

To earn the Graduate Certificate in Data Science, students must complete 15 semester credit hours as follows.

Code	Title	Credit Hours
Core Courses		9
CS 5443 or IS 6503	Database Management Systems Principles of Database Management	
DE 5103	Introduction to Data Engineering	
DE 6123	Advanced Topics in Data Engineering	
Electives		6
Select two courses from the following.		
IS 6713 or ME 6543	Data Foundations Machine Learning and Data Analytics	
IS 6973 or CS 5573 or EE 5523	Special Problems Cloud Computing Introduction to Cloud Computing	
CS 6243 or DS 5033	Machine Learning Data Mining and Machine Learning	
DS 5023	Data Organization and Visualization	
Total Credit Hours		15

Graduate Certificate in Data Science

The graduate certificate in Data Science is a 15-semester-credit-hour program designed for individuals from all academic disciplines to build an analytical and computational foundation to investigate data science problems. This certificate program is designed to fill the industry need for more data science-capable professionals and to prepare individuals for a career in data science-related fields. Individuals completing this certificate will gain practical data science knowledge, as well as hands-on skills in data organization, data visualization, data analytics, data mining, and machine learning. The certificate is administered by the University College in conjunction with the School of Data Science.

The graduate certificate in Data Science is offered in a 100 percent online format.

Admission Requirements

The certificate is open to all UTSA graduate students, including non-degree seeking students, regardless of their college or major. Applicants who are currently enrolled in a graduate degree program at UTSA have already met University requirements for admission.

Applicants who are not currently enrolled in a graduate degree program at UTSA will be required to apply for admission to UTSA as a special (non-degree-seeking) graduate student and to indicate their intent to seek admission into a certificate program (see Certificate Program Regulations in this catalog). Students who meet general UTSA admission requirements are eligible for admission to this certificate program.

As part of their application to the Graduate Certificate in Data Science program, students must submit a current résumé.

Certificate Program Requirements

To earn the Graduate Certificate in Data Science, students must complete 15 semester credit hours as follows:

Code	Title	Credit Hours
A. Required Courses (15 semester credit hours)		15
DS 5003	Introduction to Data Science	
DS 5013	Programming for Data Science	
DS 5023	Data Organization and Visualization	
DS 5033	Data Mining and Machine Learning	
STA 6003	Statistical Methods in Research and Practice I	
Total Credit Hours		15

Graduate Certificate in National Security Studies

The National Security Studies Certificate program is designed to recognize and empower students who are dedicated to the study of national and international security matters. This program offers students the opportunity to cultivate a holistic understanding of security studies, fostering interdisciplinary expertise and practical experience in various facets of this dynamic field.

Admissions Requirements

- Applicants should have a B.A. or B.S. degree, or be in their junior year of their degree in closely related fields with a minimum GPA of 3.00.
- All other applications will be evaluated on a case-by-case basis.

Program Highlights:

- **Interdisciplinary Expertise:** The National Security Studies certificate program provides a well-rounded education encompassing a wide range of subjects, including diplomacy, law, economics, history, public policy, defense, and intelligence. It encourages students to explore the multifaceted nature of security, delving into topics such as homeland security, international affairs, international development, human rights, war, conflict, peace, and related fields.
- **Professional Development:** This certificate program is geared towards equipping students with the knowledge and skills necessary to excel in careers related to national security. It places a strong emphasis on practical experience, preparing graduates for roles in government agencies, international organizations, private sector firms, and nonprofit organizations.
- **Flexibility:** Our program is designed to accommodate the needs of both full-time and part-time students, offering flexibility in scheduling and course selection. This allows individuals to pursue the certificate alongside their other academic or professional commitments.
- **Expert Faculty:** Students will benefit from the expertise of distinguished faculty members with extensive experience in the field of national security. Our instructors are dedicated to fostering a comprehensive and nuanced understanding of security studies.
- **Networking Opportunities:** The National Security Studies certificate program provides a platform for students to connect with peers who share their passion for national security issues. It also offers opportunities for networking with professionals and experts in the field through seminars, workshops, and events.

Certificate Program Requirements

To earn the Graduate Certificate in National Security Studies, students must complete 9 semester credit hours as follows.

Code	Title	Credit Hours
A. National Security Studies Courses		6
Select any two courses from below:		
NSS 5003	Introduction to National Security Studies	
NSS 5673	National Security Law and Ethics	
NSS 5013	Leadership in the Global Arena	
NSS 5233	Understanding Global Hotspots	
B. Other Security Courses		3
Select any one course from below:		
NS 6003	The Role of U.S. Intelligence in National Security	
NS 6723	National Security and Human-Digital Technology Relationships	
GLA 5973	International Politics and Cyber Security	
GLA 5783	Global Security	
GLA 5043	International Relations and World Politics	
PAD 5323	Public Policy Process	
PAD 5943	Strategic Management	
Total Credit Hours		9

Graduate Certificate in Teaching

The Graduate Certificate in Teaching is housed within University College and in partnership with the Graduate School and various colleges. The 9-semester-credit-hour certificate coursework offers students unique preparation for careers involving teaching and provides certification of training for graduate teaching. *Please note that this is *not* a Texas Educator teacher certification program.

Admission Requirements

1. Current admission as a UTSA doctoral student or postdoctoral fellow
2. Completion of 9 graduate hours of approved UTSA coursework with a GPA of 3.0 or above

Certificate Program Requirements

To earn the Graduate Certificate in Teaching, students must complete 9 semester credit hours as follows:

Code	Title	Credit Hours
A. Curriculum and Instruction		3
Select at least 3 semester credit hours from the courses below.		
CI 6003	Theory of Curriculum and Instruction	
CI 6013	Curriculum, Instruction and Assessment	
CI 7213	Instructional Strategies and Learning to Teach in Higher Education	
B. Discipline Course		3
Select 3 semester credit hours from the list below or any course not already taken from Section A.		
ANT 5583	Teaching Anthropology	
BIO 6973	Special Problems	

ENG 5183	Theory and Practice of Teaching Composition	
GBA 7103	Doctoral Teaching Seminar	
C. Graduate School Course		3
LDT 5363	Online Learning and Teaching	
Total Credit Hours		9

Data Engineering (DE) Courses

DE 5103. Introduction to Data Engineering. (3-0) 3 Credit Hours.

This course offers a comprehensive introduction to data engineering principles, methodologies, and contemporary practices. Students will delve into fundamental concepts essential for managing and processing data effectively within engineering contexts. Topics include data ingestion techniques, principles of data storage, fundamentals of data transformation, and the architecture of Extract, Transform, and Load (ETL) processes. Additionally, students will explore the design and implementation of data pipelines, emphasizing efficient and scalable data flow. Through theoretical exploration and practical exercises, students will gain the skills necessary to handle and manipulate data efficiently in engineering and environmental systems.

DE 5443. Database Management. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. This course provides a deep understanding of database systems, including relational and NoSQL databases, and their role in data storage, retrieval, and management. It also covers the concepts of Data Lake, Data Warehouse, and Data Lakehouse. Course Fee: LRMS \$37.5.

DE 6123. Advanced Topics in Data Engineering. (3-0) 3 Credit Hours.

Prerequisite: DE 5103. This course explores specialized topics in data engineering, building on foundational knowledge. Students will cover advanced concepts, including code management, version control, security, governance (data quality, stewardship, protection), data lineage, CI/CD, orchestration, monitoring, Docker, Kubernetes, and collaboration methodologies like Agile and Scrum. Through theoretical exploration and practical exercises, students will gain expertise in efficiently managing complex data engineering projects.

DE 6973. Special Topics in Data Engineering. (3-0) 3 Credit Hours.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree.

Data Science (DS) Courses

DS 5003. Introduction to Data Science. (3-0) 3 Credit Hours.

An in-depth investigation into the Data Science life cycle. Focus areas on data visualization, data curation, tools available for data analysis, and software packages will be covered.

DS 5013. Programming for Data Science. (3-0) 3 Credit Hours.

An introduction to data-driven programming emphasizing problem solving, critical thinking, and algorithmic thinking. Topics will focus on foundational computer programming concepts along with fundamentals of object-oriented programming and mathematics/statistics packages.

DS 5023. Data Organization and Visualization. (3-0) 3 Credit Hours.

Prerequisite: STA 6003, DS 5003, and DS 5013, or the equivalents. This course investigates the data organization process from data integration to analysis and visualization through program design and implementation. Topics may also include data collection and sources, file input/output, data preprocessing algorithms, and data visualization using data science software packages and APIs. Course fee: LRDS \$37.50.

DS 5033. Data Mining and Machine Learning. (3-0) 3 Credit Hours.

Prerequisite: STA 6003 and completion of or concurrent enrollment in DS 5023. This course investigates fundamental data science concepts in in-depth analysis, data mining, machine learning, and artificial intelligence. Topics may include clustering, classification, evaluation metrics, supervised and unsupervised learning, search algorithms, intelligent agents, and advanced AI applications in select areas.

DS 5043. Generative Artificial Intelligence. (3-0) 3 Credit Hours.

Prerequisite: CS 6243, CS 5233, or DS 4033. This course covers the Transformer architecture and fundamental topics such as tokenization, context windows, embeddings, etc. Students will learn to use various APIs, host language models locally, and explore the trade-offs between various state-of-the-art open-source models. Coursework will touch upon fine-tuning, prompt engineering, mitigating hallucinations, and alignment. Course Fee: LRMS \$37.50.

DS 5083. Independent Study. (0-0) 3 Credit Hours.

Prerequisite: Graduate standing and permission in writing (form available) of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$37.50.

DS 5093. Special Topics in Data Science. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics courses may be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$37.50.

Multidisciplinary Studies (MDS) Courses**MDS 5013. Advanced Writing Strategies for Multidisciplinary Studies. (3-0) 3 Credit Hours.**

This advanced writing course is designed for graduate students majoring in multidisciplinary studies. Through presentations, readings, discussion, and writing, graduate students will develop writing and editing skills necessary for their success in the Multidisciplinary Studies Graduate program. This course focuses on effective academic writing strategies and techniques, such as argumentation, organization, research, audience, genre, style, and more. Course Fee: LRMS \$37.50.

MDS 6833. Capstone for Multidisciplinary Studies. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing and permission in writing (form available) of the instructor and the Graduate Advisor of Record. This is a project-based course in which students collaborate on projects spanning various specialization areas. It serves as a pivotal opportunity for students to integrate their academic knowledge into practical, real-world applications and cultivate the essential skills needed to collaborate effectively across disciplines. Through engaging in hands-on projects, students deepen their understanding of course content and develop invaluable teamwork, problem-solving, and communication skills essential for success in diverse professional settings. Course Fee: LRMS \$37.50.

MDS 6941. Internship. (0-0) 1 Credit Hour.

Prerequisite: Consent of Graduate Advisor of Record. Supervised experience, relevant to the student's program of study, within selected organizations and agencies. May be repeated for credit but not more than 6 hours will apply to the Master's degree. Course Fee: LRMS \$12.50.

MDS 6943. Internship. (0-0) 3 Credit Hours.

Prerequisite: Consent of Graduate Advisor of Record. Supervised experience, relevant to the student's program of study, within selected organizations and agencies. May be repeated for credit but not more than 6 hours will apply to the Master's degree. Course Fee: LRMS \$37.50.

MDS 6951. Independent Study. (0-0) 1 Credit Hour.

Prerequisite: Graduate standing and permission in writing (form available) of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$12.50.

MDS 6953. Independent Study. (0-0) 3 Credit Hours.

Prerequisite: Graduate standing and permission in writing (form available) of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$37.50.

MDS 6961. Comprehensive Examination. (0-0) 1 Credit Hour.

Prerequisite: Approval of the Graduate Advisor of Record and the student's Comprehensive Examination Committee. Independent study course for the purpose of taking the Comprehensive Examination. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). Course Fee: LRMS \$12.50.

MDS 6971. Special Topics. (1-0) 1 Credit Hour.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics courses may be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$12.50.

MDS 6973. Special Topics. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics courses may be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$37.50.

National Security Studies (NSS) Courses

NSS 5003. Introduction to National Security Studies. (3-0) 3 Credit Hours.

This course will provide an introduction to the American national security apparatus and the principal threats it seeks to manage. It will review relevant theories of international relations to understand and explain the international security environment, examine ongoing security concerns, examine varying strategic approaches for the conduct of American national security, and review the historical development and contemporary policies and practices of American national security institutions. These theories, practices, and institutions will be examined through the lens of case studies of specific security concerns, from terrorism to human security to warfare. Students completing this course will demonstrate an understanding of the national security policy process, the international security environment, theoretical and strategic perspectives on national security, and the history and practices of American national security institutions, including the armed forces, the Central Intelligence Agency, and more. (Same as NSS 4003. Credit cannot be earned for both NSS 4003 and NSS 5003.). Course Fee: LRMS \$12.50.

NSS 5013. Leadership in the Global Arena. (3-0) 3 Credit Hours.

Through an interactive approach, students will grow their self, team, and organizational leadership skills. This multi-faceted course encourages personal growth while also exploring historical leaders and different leadership styles. The course will include a variety of approaches, including hands-on leadership practice, case studies, guest speakers, etc., to further develop skills to effectively lead in various contexts, cultures, and countries. (Same as NSS 4013. Credit cannot be earned for both NSS 4013 and NSS 5013.). Course Fee: LRMS \$12.50.

NSS 5233. Understanding Global Hotspots. (3-0) 3 Credit Hours.

This course explores current major conflicts around the world by examining their causes, history, and possible future outcomes. Students will explore the role of geography, economics, religion, culture, and other factors as they relate to global politics to better understand foreign policy approaches to complex geopolitical tensions. (Same as NSS 4233. Credit cannot be earned for both NSS 4233 and NSS 5233.). Course Fee: LRMS \$12.50.

NSS 5673. National Security Law and Ethics. (3-0) 3 Credit Hours.

While war seems like unrestrained violence, the American security establishment is meaningfully constrained in numerous ways, some relating to concrete laws and policies and others relating to broader ethical concerns. This course will provide an introduction to national security law and ethics, including U.S. Constitutional Law relating to war powers, U.S. domestic laws and institutions, international laws and norms of warfare, ethical debates concerning these laws, and studies of historical cases which have stressed or stretched these laws, including the September 11th, 2001, terrorist attacks. Students completing this course will demonstrate a general understanding of domestic and international law in the area of national security, and an understanding of ethical reasoning relating to the conduct of U.S. security. (Same as NSS 4673. Credit cannot be earned for both NSS 4673 and NSS 5673.). Course Fee: LRMS \$12.50.

NSS 6973. Special Topics in National Security Studies. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$12.50.

Quantum Science and Technology (QST) Courses

QST 6003. Introduction to Quantum Information. (3-0) 3 Credit Hours.

Prerequisite: MAT 2233 or equivalent. Fundamentals of quantum information and its classical counterparts. Basic principles of quantum mechanics, such as entanglement, are approached from the information perspective for computing, communications, and sensing. Quantum computing elements include qubits, quantum gates, and quantum circuits. Course Fee: LRMS \$37.50.

QST 6103. Quantum Cybersecurity. (3-0) 3 Credit Hours.

Prerequisite: IS 6303 and QST 6003, or consent of instructor. Cybersecurity in quantum computing. Post-quantum encryption, IT/OT security in the quantum computing stack from base architecture to algorithms. Course Fee: LRMS \$37.50.

QST 6123. Quantum Computing. (3-0) 3 Credit Hours.

Prerequisite: QST 6003, and prior completion of an Introduction to Programming course or consent of instructor. Corequisites: QST 6203. A project-based quantum computing course covering the practical implementation of quantum algorithms and software. The course begins by covering the theoretical analysis of existing quantum algorithms, and we then cover strategies for implementing quantum software for specific quantum architectures. Topics covered include Shor's Algorithm, Grover's algorithm, stack computing, quantum compilers/transpilers, and quantum-classical computing challenges. Course Fee: LRMS \$37.50.

QST 6203. Quantum Sensing. (3-0) 3 Credit Hours.

Prerequisite: Prior completion of a Calculus, Linear Algebra, and Differential Equations course or consent of instructor. Corequisites: QST 6003. Foundations of quantum sensing, including qubits, coupling to classical fields, and decoherence. Quantum sensing technology applications and comparison to classical sensing with superconducting, photonic, and other quantum hardware. Quantum and classical transduction and materials for sensing. Quantum advantage with entangled sensors. Course Fee: LRMS \$37.50.

QST 6973. Special Topics in Quantum Computing. (3-0) 3 Credit Hours.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but no more than 6 hours, regardless of discipline, will apply to the degree. Course Fee: LRMS \$37.50.