DEPARTMENT OF BIOMEDICAL ENGINEERING AND CHEMICAL ENGINEERING

The Department of Biomedical Engineering and Chemical Engineering offers a Graduate Certificate in Medical Device Commercialization, a Graduate Certificate in Engineering Education, a Master of Science degree in Biomedical Engineering, a Master of Science degree in Biomedical Technology and Commercialization, a Master of Science degree in Chemical Engineering, a Master of Science degree in Engineering Education, a Doctor of Philosophy degree in Biomedical Engineering, and a Doctor of Philosophy degree in Chemical Engineering.

Master of Science Degree in Biomedical Technology Commercialization

A Master of Science (M.S.) degree in Biomedical Technology Commercialization (BTC) at The University of Texas at San Antonio is a joint graduate program between the Department of Biomedical Engineering and Chemical Engineering in the Klesse College of Engineering and Integrated Design and the Department of Information Systems and Cyber Security in the Carlos Alvarez College of Business. This is a non-thesis degree program, and the M.S. degree will be awarded to candidates who have satisfactorily completed all degree requirements for the program.

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

Admission Requirements

Students who hold an undergraduate degree in engineering, sciences, or business administration may apply to the program. The minimum requirements for admission to the Master of Science in Biomedical Technology Commercialization degree are described below. Note that satisfying these requirements does not guarantee admission.

- Applicants must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science, engineering, or business discipline. Students with borderline grade point average (between 2.9 and 3.0) will be required to satisfactorily complete selected courses as a condition of acceptance.
- Graduate Record Examination (GRE) or Graduate Management Admission Test (GMAT) scores are not required for admission consideration.
- A minimum of one letter of recommendation attesting to the applicant's readiness for graduate study must be submitted.
- Students whose native language is not English must achieve a university-wide minimum score on either the Test of English as a Foreign Language (TOEFL) iBT or the International English Language Testing System (IELTS). The current university-wide minimum score for TOEFL iBT is 79 and IELTS is 6.5. Students are encouraged to review the Graduate Catalog for any changes in the university-wide minimum scores for TOEFL/IELTS. Note that TOEFL/IELTS scores older than two years are not valid or accepted. This test score is waived for international students from countries where English is the official language, or for students who have earned an accredited bachelor's degree or higher in the United States or in countries where English is the official language, as indicated in the Graduate Catalog.

A complete application includes the application form, official transcripts, letter(s) of recommendation, and English Proficiency test (TOEFL or IELTS) scores, if applicable.

Degree Requirements and Program of Study

The Master of Science (M.S.) degree in Biomedical Technology Commercialization (BTC) will consist of at least 30 semester credit hours beyond the bachelor's degree. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. For transferring students, course credit allowed for transfer will be decided on a case-by-case basis by the program director and the admissions committee for Biomedical Technology Commercialization. If recommended by the program director and admissions committee, the request will then be submitted to the Dean of the Graduate School for approval. The required curriculum for all students is as follows:

Code	Title	Credit Hours
A. Core courses		**18**
Required Core Courses offered in the College of Engineering:		
BME 6123	Medical Device Design	
BME 6403	Biomedical Terminologies for Entrepreneurs	
BME 6413	Working Knowledge in the Biomedical Industries	
Required Core Courses offered in the College of Business:		
MOT 5053	Technology Commercialization	
MOT 5243	Essentials of Project Management	
MOT 5343	Financial Aspects of Management of Technology	
B. Electives		**9**
A minimum of 9 semester credit hours of prescribed courses selected from approved courses below or substitution of appropriate courses by the program director.		
BME 6303	Introduction to Python with Applications to Biomedical Industries	
BME 6723	Bioinstrumentations	
BME 6913	Biomaterials II	
BME 6943	Biomaterials and Cell Signaling	
BME 6953	Biomaterials for Drug Delivery/ Pharmacology	
MOT 5213	Organizational Systems for Management of Technology	
MOT 5253	Starting the High-Tech Firm	
C. Final Project		**3**

The final project, in the area of Biomedical Technology Commercialization, is a one-semester project and will be conducted under the guidance of an instructor and approved by the program. Students may opt for a comprehensive exam in lieu of a final project. Students opting for comprehensive exam will need prior approval from the program director. Project/exam will be documented and filed with the student's dossier, indicating successful completion of the project/exam.		
BME 6133	Biomedical Project	
Total Credit Hours		**30**

Master of Science Degree in Biomedical Engineering

A Master of Science (M.S.) degree in Biomedical Engineering (BME) at The University of Texas at San Antonio is offered jointly through The University of Texas Health Science Center at San Antonio. A matrix of academic tracks is offered based on segments of biomedical engineering and/or areas of clinical emphasis. Specifically, the program has emphases in the following areas: biomaterials, biomechanics, and bioimaging. The biological areas covered are orthopedics/dental tissues, cardiovascular systems, and neural systems. The M.S. degree in Biomedical Engineering (Thesis Option or Non-Thesis Option) will be awarded to candidates who have displayed an in-depth understanding of the concepts that are necessary for critically judging the scientific literature, for formulating novel hypotheses, designing experimental protocols to test the hypotheses, interpreting their results, and demonstrating their ability to make an original contribution to knowledge in the biomedical field.

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

Admission Requirements

Students who hold an undergraduate degree may apply to the program. The minimum requirements for admission to the Master of Science in Biomedical Engineering degree are described below. Note that admission is competitive, and satisfying these requirements does not guarantee admission.

- Applicants must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science or engineering discipline. All students should have had sufficient background in engineering, chemistry, biology, and physics prior to being admitted to the program. It is expected that these students will have a bachelor's degree with an emphasis in either engineering, physical science, or biological science disciplines. All students are required to have completed at least one year of engineering physics, chemistry, biology, and mathematics (up to Differential Equations I or Applied Engineering Analysis I). Students with deficiencies in the above courses will be required to satisfactorily complete selected courses as a condition of acceptance.
- Students whose native language is not English must achieve a university-wide minimum score on the Test of English as a Foreign Language (TOEFL) iBT or the International English Language Testing System (IELTS). The current university-wide minimum score for the TOEFL iBT is 79 and IELTS is 6.5. Students are also encouraged to review the Graduate Catalog for any changes in the university-wide minimum scores for TOEFL/IELTS. This test score is waived for international students from countries where English is the official language or for students who have earned an accredited bachelor's degree or higher in the United States or in countries where English is the official language, as indicated in the Graduate Catalog.
- A minimum of two letters of recommendation are required (three are preferred) to attest to the applicant's readiness for graduate study.
- A complete application includes the application form, official transcripts, letters of recommendation, a résumé, English proficiency test (TOEFL or IELTS) scores if applicable, and a statement of the applicant's research experience, interests, and goals.

Degree Requirements and Program of Study – Thesis Option

The Master of Science (M.S.) degree in Biomedical Engineering (BME) will consist of at least 32 semester credit hours beyond the bachelor's degree. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. For transferring students, course credit allowed for transfer will be decided on a case-by-case basis by the Biomedical Engineering Committee on Graduate Studies (COGS). If recommended by the COGS, the request will then be submitted to the Dean of the Graduate School for approval. Since this is a joint graduate program, some courses are offered at UT Health San Antonio. To enroll in UT Health San Antonio courses (UT Health San Antonio Catalog (http://catalog.uthscsa.edu/)), students must register through the UT Health San Antonio website (http://www.uthscsa.edu). Any questions concerning registration at UT Health San Antonio should be directed to the BME Program Office at UT Health San Antonio. The required curriculum for all students in the Thesis Option is as follows:

Code	Title	Credit Hours
A. Core courses		**14**
Required core courses offered through UT San Antonio:		
BME 6033	BME Engineering Analysis	
BME 6703	Biomedical Imaging	
BME 6803	Experimental Biomechanics	
BME 6903	Biomaterials	
Required core courses offered through UT Health San Antonio:		
BIME 6004	Biology for Bioengineers [1]	
BIME 6006	Physiology for BME [1]	
TSCI 5070	Responsible Conduct of Patient-Oriented Clinical Research	
B. Research seminar		**3**
BME 6011 (or BIME 6090 at UT Health San Antonio) is required for three semesters, in order to satisfy the requirements for the Master's degree program in Biomedical Engineering.		
C. Elective courses		**9**
A minimum of 9 semester credit hours of elective courses selected from the list below. Courses not on this list may be taken with the approval of the BME Program.		
UT San Antonio Prescribed Elective Courses:		
BME 6053	Independent Study in Biomedical Engineering (or BME 6052, BME 6051)	
BME 6093	Topics in Biomedical Engineering	
BME 6123	Medical Device Design	
BME 6143	Biomedical Device Development	
BME 6203	Physiology for Engineers	

BME 6213	Cellular Engineering	
BME 6233	Cardiovascular Bioengineering	
BME 6723	Bioinstrumentations	
BME 6733	Microfabrication and Application	
BME 6743	Biophotonics	
BME 6753	Biosensors: Fundamentals and Applications	
BME 6793	Topics in Image and Signal Processing	
BME 6823	Advanced Biomechanics	
BME 6843	Tissue Mechanics	
BME 6893	Topics in Biomechanics	
BME 6913	Biomaterials II	
BME 6923	Tissue Engineering	
BME 6933	Tissue-Biomaterials Interactions	
BME 6943	Biomaterials and Cell Signaling	
BME 6963	Fundamentals to Polymer Science with Select Biomedical Applications	
ME 5713	Mechanical Behavior of Materials	
MOT 5163	Management of Technology	
MOT 5243	Essentials of Project Management	
UT Health San Antonio Prescribed Elective Courses:		
BIME 5091	Independent Study	
CSAT 5022	Interprofessional Human Gross Anatomy	
CSAT 5095	Experimental Design and Data Analysis	
INTD 5007	Advanced Cell and Molecular Biology	
INTD 6033	Cell Signaling Mechanisms	
MICR 5051	Introduction to Immunology	
PHAR 5013	Principles of Pharmacology	
RADI 6016	Physics of Diagnostic Imaging II	
RADI 6051	Statistical Parametric Imaging	
D. A minimum of 6 semester credit hours of biomedical engineering Master's Thesis Research is required.		**6**
BIME 6098	Thesis	
BME 6981	Master's Thesis Research	
BME 6982	Master's Thesis Research	
BME 6983	Master's Thesis Research	
BME 6986	Master's Thesis Research	
Total Credit Hours		**32**

[1] Only one course is needed to satisfy the core requirement.

The entire program of study must be recommended by the student's Master's Thesis Advisor, Master's Thesis Committee, and the COGS and must be submitted to the Dean of the Graduate School for approval. The courses taken by students are intended to focus and support the individual's mastery of his or her particular area of specialization.

Advancement to Candidacy

The student should seek recommendations from the COGS for advancement to candidacy. The COGS reserves the right to deny recommendation of the student's admission to Master's candidacy based on the student's academics and proposed research. Upon recommendation from the COGS, all students are admitted to candidacy after successfully defending their proposed research, recommended by his/her Master's Thesis Committee, and approved by the Dean of the Graduate School. Students should also consult the University Master's Degree Regulations in this catalog for the other pertinent requirements.

Thesis Defense

A thesis, which is an original contribution to scholarship, based on independent investigation (graduate research) in the major area, is required of every candidate. The Master's thesis research will be conducted by the student under the guidance of the Supervising Professor and the advice of the Master's Thesis Committee. Prior to starting the thesis research, each student will submit a research proposal to the COGS for approval. The thesis will be the responsibility of the student and the Supervising Professor. Registration for thesis credit hours must be for a period of more than one semester. During each semester that a student receives advice and/or assistance from a faculty member or supervision by the Master's Thesis Committee or uses UT San Antonio or UT Health San Antonio resources, he or she will be required to enroll for credit in the appropriate Master's degree course. The form and format of the thesis should follow the guidelines and rules already in effect at UT San Antonio or UT Health San Antonio.

Composition of the Master's Thesis Committee

The Master's Thesis Committee is made up of at least four members. The committee should consist of the Supervising Professor, one BME Graduate Faculty member from UT San Antonio, one BME Graduate Faculty member from UT Health San Antonio, and one external member. The student's thesis proposal and the proposed composition of the Master's Thesis Committee will be evaluated and approved by the COGS.

Final Oral Examination (Defense of Thesis)

A satisfactory final oral examination is required for the approval of a thesis. Acceptance of the thesis will be contingent upon approval of the respective Master's Thesis Committee. The thesis defense consists of a seminar presentation by the candidate to the general public. A closed-door examination by the Master's Thesis Committee follows and covers the general field of the thesis and other parts of the student's program as determined by the respective committee. Members of the Master's Thesis Committee must be satisfied that the student has:

1. Completed the research approved by the Master's Thesis Committee.
2. Passed all examinations required by the COGS, including the successful defense of the thesis.
3. Completed the required coursework.
4. Completed a thesis that is an independent investigation in the biomedical engineering field and constitutes a contribution to the respective discipline.

Upon successful completion of the aforementioned requirements, the Master's Thesis Committee members will sign the approval forms for the Master's Thesis and make an official recommendation to the Graduate School of Biomedical Sciences at UT Health San Antonio or to the Graduate School at UT San Antonio that the Master's degree be awarded.

Degree Requirements and Program of Study – Non-Thesis Option

The Non-Thesis Option is not offered to new incoming students. All students enrolled in the Non-Thesis Option will require approval from the Program Director and the Graduate Advisor of Record. The Master of Science (M.S.) degree in Biomedical Engineering (BME) (Non-Thesis Option) will consist of at least 36 semester credit hours beyond the bachelor's degree. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. For transferring students, course credit allowed for transfer will

be decided on a case-by-case basis by the Biomedical Engineering Committee on Graduate Studies (COGS). If recommended by the COGS, the request will then be submitted to the Dean of the Graduate School for approval. Since this is a joint graduate program, some courses are offered at The University of Texas Health Science Center at San Antonio. To enroll in UT Health San Antonio courses (UT Health San Antonio Catalog (http://catalog.uthscsa.edu/)), students must register through the UT Health San Antonio website (http://www.uthscsa.edu). Any questions concerning registration at UT Health San Antonio should be directed to the BME Program Office at UT Health San Antonio. The required curriculum for all BME students in the Non-Thesis Option is as follows:

Code	Title	Credit Hours
A. Core Courses:		**18**
Required core courses offered through UT San Antonio: (All courses listed below.)		
BME 6033	BME Engineering Analysis	
BME 6703	Biomedical Imaging	
BME 6803	Experimental Biomechanics	
BME 6903	Biomaterials	
Required core courses offered at UT Health San Antonio:		
BIME 6004	Biology for Bioengineers [1]	
BIME 6006	Physiology for BME [1]	
TSCI 5070	Responsible Conduct of Patient-Oriented Clinical Research	
B. Research seminar		**3**
BME 6011 (or BIME 6090 at UT Health San Antonio) is required for four semesters, in order to satisfy the requirements for the Master's degree program in Biomedical Engineering		
C. Electives		**15**
A minimum of 15 semester credit hours of prescribed elective courses selected from the Thesis option above. Courses not on this list may be taken with the approval of the BME Program.		

[1] Only one course is needed to satisfy the core requirement.

Master of Science Degree in Chemical Engineering

The M.S. in Chemical Engineering program is designed to equip students with the knowledge and skills necessary to excel as leaders in chemical engineering industries and research and development. Through a robust academic curriculum, students will gain a strong foundation in fundamental principles while also developing specialized skills essential for managing and leading within the field. The program will emphasize the resolution of contemporary challenges in areas such as advanced process development, automation strategy, data analytics, risk management, and reliability engineering. By fostering both technical expertise and leadership capabilities, this program aims to produce graduates who are well-prepared to drive innovation and make impactful contributions to the chemical engineering sector.

Admissions Requirements

Successful Chemical Engineering applicants must satisfy the University-wide graduate admission requirements described in the Graduate Catalog. In addition, they must satisfy the following Chemical Engineering-specific requirements:

- Hold a Bachelor of Science in Chemical Engineering or a related field. The degrees must be from an accredited institution. If the degree of an applicant is in an area other than Chemical Engineering, they may be required to take foundation courses.
- A minimum Grade Point Average (GPA) of 3.0 in upper-division courses.
- Complete applications must include the following:
  - Official transcripts;
  - International applicants are required to prove proficiency in the English language by taking either the Test of English as a Foreign Language (TOEFL) iBT, the International English Language Testing System (IELTS), or the Duolingo English Test (DET). The minimum acceptable scores for admissions consideration are 79 TOEFL iBT, 6.5 IELTS, and 100 DET. Scores may not be more than two years old.
  - Three letters of recommendation from persons familiar with the applicant's academic potential;
  - Statement of research/specialization interest;
  - Résumé/curriculum vitae.

Applications must be submitted to the UTSA Office of Strategic Enrollment. Incomplete applications will not be considered. Acceptance to the program is determined by the Department's Graduate Studies Committee. The Graduate Studies Committee is comprised of the Graduate Advisor of Record (GAR) and two additional members of the faculty. Members will be appointed by the Department Chair for a two-year term.

Degree Requirements

A minimum of 36 semester credit hours are required to complete the M.S. in Chemical Engineering. Full-time graduate students must enroll in at least 9 semester credit hours per semester, making the 36-credit requirement consistent with full-time enrollment over two years (18 hours per year for 2 years).

Code	Title	Credit Hours
A. Required Courses		
CME 6103	Chemical Engineering Kinetics and Reactor Design	3
CME 6203	Advanced Chemical Engineering Thermodynamics	3
CME 6303	Transport Phenomena	3
CME 6403	Mathematical Methods in Chemical Engineering	3
CME 6601	Chemical Engineering Research Seminar (repeated for a total of 3 hours)	3
B. Concentration Courses		**21**
Complete 21 semester credit hours from one of the concentrations below.		
Research and Development Concentration		
Students in the Research and Development concentration may apply 6 semester credit hours of Master's Thesis coursework towards their concentration.		
BME 6043	Critical Thinking and Writing for BME	
BME 6093	Topics in Biomedical Engineering	
BME 6123	Medical Device Design	
BME 6213	Cellular Engineering	

BME 6303	Introduction to Python with Applications to Biomedical Industries
BME 6403	Biomedical Terminologies for Entrepreneurs
BME 6703	Biomedical Imaging
BME 6743	Biophotonics
BME 6803	Experimental Biomechanics
BME 6843	Tissue Mechanics
BME 6893	Topics in Biomechanics
BME 6903	Biomaterials
BME 6933	Tissue-Biomaterials Interactions
CME 5503	Chemical Engineering Ethics and Leadership
CME 6113	Heterogeneous Catalysis and Surface Science
CME 6123	Electrochemical Engineering
CME 6133	Biochemical Engineering
CME 6703	Electronic and Local Atomic Structure using Synchrotron Methods
CME 6803	Introduction to Polymer Science and Engineering
CME 6813	Self-healing Polymers
CME 6903	Fundamentals of Interfaces, Nanoparticles, and other Colloids
CME 6943	Chemical Engineering Internship
CME 6951	Independent Study in Chemical Engineering
CME 6952	Independent Study in Chemical Engineering
CME 6953	Independent Study in Chemical Engineering
CME 6973	Topics in Chemical Engineering
CME 6981	Master's Thesis (coming soon)
CME 6982	Master's Thesis (coming soon)
CME 6983	Master's Thesis (coming soon)
CME 6986	Master's Thesis (coming soon)
CE 5613	Environmental Chemistry
CE 5623	Advanced Treatment Processes for Water Quality Control
CE 5643	Sustainable Energy Systems
CE 5733	Special Topics in Environmental Engineering
CE 6383	Global Change
or ES 5043	Global Change
CE 6603	Fate and Transport of Contaminants in the Environment
CHE 6973	Special Problems
ES 5063	Environmental Microbiology
MATE 5113	Functions, Evaluations and Synthesis Technology of Advanced Materials
MATE 5213	Sensing and Sensor Materials
MATE 5223	Structure-Chemistry-Property Relations in Materials Science and Engineering
MATE 5253	Magnetic Materials and Electromagnetic Engineering
ME 5213	Topics in Systems Modeling
ME 5233	Advanced Quality Control
ME 5273	Alternative Energy Sources
ME 5453	Advanced Strength of Materials
ME 5483	Finite Element Methods
ME 5473	Viscoelasticity
ME 5503	Lean Manufacturing and Lean Enterprises
ME 5563	Computer Integrated Manufacturing
ME 5583	Process Improvement and Variability Reduction
ME 5603	Advanced Manufacturing Systems Engineering
ME 5643	Green and Sustainable Manufacturing and Enterprise Systems
ME 5653	Computational Fluid Dynamics
ME 5743	Composite Materials
ME 6033	Linear and Mixed Integer Optimization
ME 6123	Advanced Systems Dynamics and Control
ME 6543	Machine Learning and Data Analytics
ME 6613	Advanced Fluid Mechanics
Management Concentration	
BME 6043	Critical Thinking and Writing for BME
BME 6303	Introduction to Python with Applications to Biomedical Industries
CME 5503	Chemical Engineering Ethics and Leadership
CME 6943	Chemical Engineering Internship
CME 6951	Independent Study in Chemical Engineering
CME 6952	Independent Study in Chemical Engineering
CME 6953	Independent Study in Chemical Engineering
CE 6383	Global Change
or ES 5043	Global Change
DA 6213	Data-Driven Decision Making and Design
GBA 6302	Professional Development and Communication
IS 6713	Data Foundations
ME 5233	Advanced Quality Control
ME 5503	Lean Manufacturing and Lean Enterprises
ME 5643	Green and Sustainable Manufacturing and Enterprise Systems
MGT 6971	Special Problems
MGT 5093	Leadership
MGT 5253	Ethics and Globalization
MOT 5053	Technology Commercialization
MOT 5243	Essentials of Project Management
MS 5003	Quantitative Methods for Business Analysis
MS 5023	Decision Analytics for Managers
STA 6543	Predictive Modeling
Advanced Process Development Concentration	
BME 6043	Critical Thinking and Writing for BME
BME 6303	Introduction to Python with Applications to Biomedical Industries
CME 5503	Chemical Engineering Ethics and Leadership

CME 6113	Heterogeneous Catalysis and Surface Science
CME 6123	Electrochemical Engineering
CME 6133	Biochemical Engineering
CME 6703	Electronic and Local Atomic Structure using Synchrotron Methods
CME 6803	Introduction to Polymer Science and Engineering
CME 6813	Self-healing Polymers
CME 6903	Fundamentals of Interfaces, Nanoparticles, and other Colloids
CME 6943	Chemical Engineering Internship
CME 6951	Independent Study in Chemical Engineering
CME 6952	Independent Study in Chemical Engineering
CME 6953	Independent Study in Chemical Engineering
CME 6973	Topics in Chemical Engineering
CE 5613	Environmental Chemistry
CE 5623	Advanced Treatment Processes for Water Quality Control
CE 5643	Sustainable Energy Systems
CE 5733	Special Topics in Environmental Engineering
CE 6383	Global Change
or ES 5043	Global Change
CE 6603	Fate and Transport of Contaminants in the Environment
ES 5063	Environmental Microbiology
MATE 5113	Functions, Evaluations and Synthesis Technology of Advanced Materials
ME 5213	Topics in Systems Modeling
ME 5233	Advanced Quality Control
ME 5273	Alternative Energy Sources
ME 5453	Advanced Strength of Materials
ME 5483	Finite Element Methods
ME 5503	Lean Manufacturing and Lean Enterprises
ME 5563	Computer Integrated Manufacturing
ME 5583	Process Improvement and Variability Reduction
ME 5603	Advanced Manufacturing Systems Engineering
ME 5643	Green and Sustainable Manufacturing and Enterprise Systems
ME 5653	Computational Fluid Dynamics
ME 6033	Linear and Mixed Integer Optimization
ME 6123	Advanced Systems Dynamics and Control
ME 6543	Machine Learning and Data Analytics
ME 6613	Advanced Fluid Mechanics
Total Credit Hours	**36**

Degree Options

Students seeking the M.S. in Chemical Engineering with a concentration in Research and Development must select between two options to complete the 21 semester credit hours. Students in the Management or Advanced Process Development concentrations may not select the thesis option.

Option 1: Non-Thesis Option

All students in the Management and Advanced Process Development concentrations and students in the Research and Development concentration who choose the Non-Thesis Option are required to complete the 15 semester credit hours of required coursework and 21 semester credit hours of concentration coursework.

Option 2: Thesis Option (coming soon)

Students in the Research and Development concentration who choose the Thesis Option are required to complete the 15 semester credit hours of required coursework, 15 semester credit hours of concentration coursework, and 6 semester credit hours of CME Master's Thesis (coming soon). See the University's requirements for a thesis in the the Master's Degree Regulations.

Master of Science Degree in Engineering Education

The Master of Science (M.S.) degree in Engineering Education is a graduate program designed by the Klesse College of Engineering and Integrated Design and the College of Education and Human Development. It promotes the integration of both research and practice in engineering education and engineering through collaboration among professors in the two colleges. It provides a platform for students who plan to conduct fundamental research in engineering teaching and learning, as well as those interested in teaching engineering or pre-engineering subjects in high schools, community colleges, or four-year engineering programs. The program focuses deeply on an inclusive and critical pedagogy that values the wide diversity of students and their unique strengths while offering mentorship and support. The interdisciplinary nature of the program also allows for the integration of both theory and application of pedagogical approaches in formal, informal, and corporate settings. The M.S. degree in Engineering Education can prepare graduate student educators to strengthen their students' opportunities for academic success and workforce and career preparation in the STEM fields.

The program offers both a thesis and a non-thesis degree option. Engineering Education M.S. students must take a minimum of 30 semester credit hours beyond their bachelor's degree.

The thesis M.S. program option requires students to:

1. Complete a minimum of 30 semester credit hours in required courses, including: 9 credits in Engineering Education core courses, a 1-credit seminar course, a 2-credit practicum, a minimum of 6 credits in Engineering Education elective courses, 6 credits in defined core research theory courses, and a minimum of 6 credits in Master's Thesis research courses.
2. Maintain a minimum cumulative GPA of 3.0 during graduate study.

The non-thesis M.S. program option requires students to:

1. Complete a minimum of 30 semester credit hours in required courses, including: 9 credits in Engineering Education core courses, a 1-credit seminar course, a 2-credit practicum, a 3-credit graduate project course, and a minimum of 15 credits in Engineering Education elective courses *or* 9 credits in Engineering Education elective courses and a minimum of 6 credits of elective graduate-level courses, primarily from the Klesse College of Engineering and

Integrated Design and from the various departments in areas such as biomedical engineering, civil engineering, computer engineering, electrical engineering, materials engineering, and mechanical engineering.

2. Maintain a minimum cumulative GPA of 3.0 during graduate study.

The M.S. degree will be awarded to candidates who have satisfactorily completed all degree requirements for the program.

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

Admission Requirements

Students who hold an undergraduate degree or will complete their undergraduate degree before enrollment may apply to the program. The minimum requirements for admission to the Master of Science degree in Engineering Education are described below. Note that satisfying these requirements alone does not guarantee admission.

- Applicants must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science, engineering, or STEM education discipline. It is expected that applicants will have a bachelor's degree with an emphasis in one or more of the following disciplines: engineering, engineering technology, computer science, science, mathematics, education (with specialization in mathematics, earth science, elementary science, biology, chemistry, physics, environmental science, general science, or other STEM-related education), or certification in teaching STEM subjects.
- Official transcripts will need to be submitted prior to admission. For international applicants or applicants that have completed their degree outside of the USA, please provide an officially translated transcript certifying course-by-course equivalence with the US grading system and showing cumulative GPA.
- GRE scores are not required.
- Students whose native language is not English must achieve a university-wide minimum score requirement on the Test of English as a Foreign Language (TOEFL) iBT or the International English Language Testing System (IELTS). The current university-wide minimum score requirement for the TOEFL iBT is 79 and IELTS is 6.5. This test score is waived for international students from countries where English is the official language or for students who have earned an accredited bachelor's degree or higher in the United States or in countries where English is the official language, as indicated in the *Student Policies* admission section.
- A minimum of two letters of recommendation are required to attest to the applicant's readiness for graduate study.
- A statement of purpose, between 500 and 1,000 words, is required and must convey who you are, present your academic and professional interests, discuss what you expect to gain from this graduate program, and state how you will add value to the graduate program community.

A complete application includes the application form, official transcripts, letters of recommendation, English proficiency test (TOEFL or IELTS) scores, if applicable, and the statement of purpose.

Degree Requirements – Thesis Option

Code	Title	Credit Hours
A. Core Courses (select 3 courses from below)		**9**
EGR 6183	Engineering Education Methods	
EGR 6283	Mentored Teaching in Engineering	
EGR 6973	Special Problems: Becoming an Engineering Educator	
or CI 6973	Special Problems	
B. Seminar		**1**
EGR 6991	Research Seminar	
C. Core Research Theory (a minimum of 6 credit hours)		**6**
EGR 6653	Foundations of Engineering Education Research Methodologies	
EGR 6853	Advanced Engineering Education Research Methodologies	
(or other approved research methods course from within the College of Education and Human Development. Recommended: 3 hours of qualitative research methodology and 3 hours of quantitative research methodology)		
D. Masters Research (a minimum of 6 credit hours)		**6**
EGR 6983	Master's Thesis Research (repeated to reach 6 semester credit hours)	
or EGR 6981	Master's Thesis Research	
or EGR 6982	Master's Thesis Research	
E. Practicum		**2**
EGR 6932	Engineering Education Practicum	
F. Engineering Education Electives (select 2 courses from below)		**6**
EGR 6293	Professional Development in Engineering Education	
EGR 6313	Teaching Engineering through Spatial Visualization	
EGR 6453	Engineering for Social Justice	
EGR 6463	Engineering Social Responsibility and Ethics	
EGR 6513	Human Centered Design and the Impact of Modern Technologies	
EGR 6653	Foundations of Engineering Education Research Methodologies	
EGR 6853	Advanced Engineering Education Research Methodologies	
EGR 6913	Advanced Topics in Interdisciplinary STEM Education	
CI 6613	Nature and Meaning of Interdisciplinary STEM Education	
CI 6623	Inquiry in Interdisciplinary STEM Education	
CI 6633	Equity, Agency, and Participation in Interdisciplinary STEM Education	
CI 6643	Assessment in Interdisciplinary STEM Education	
Total Credit Hours		**30**

Degree Requirements – Non-Thesis Option

Code	Title	Credit Hours
A. Core Courses (select 3 courses from below)		**9**
EGR 6183	Engineering Education Methods	
EGR 6283	Mentored Teaching in Engineering	
EGR 6973	Special Problems: Becoming an Engineering Educator	
or CI 6973	Special Problems	
B. Seminar		**1**
EGR 6991	Research Seminar	
C. Graduate Project		**3**
EGR 6943	Graduate Project	
D. Practicum		**2**
EGR 6932	Engineering Education Practicum	
E. Engineering Education Electives		**9**
EGR 6293	Professional Development in Engineering Education	
EGR 6313	Teaching Engineering through Spatial Visualization	
EGR 6453	Engineering for Social Justice	
EGR 6463	Engineering Social Responsibility and Ethics	
EGR 6513	Human Centered Design and the Impact of Modern Technologies	
EGR 6653	Foundations of Engineering Education Research Methodologies	
EGR 6853	Advanced Engineering Education Research Methodologies	
EGR 6913	Advanced Topics in Interdisciplinary STEM Education	
CI 6613	Nature and Meaning of Interdisciplinary STEM Education	
CI 6623	Inquiry in Interdisciplinary STEM Education	
CI 6633	Equity, Agency, and Participation in Interdisciplinary STEM Education	
CI 6643	Assessment in Interdisciplinary STEM Education	
F. Engineering Education or Engineering Electives		**6**
Students may take an additional 6 hours of Engineering Education Electives (see previous section). The degree program (non-thesis option) also offers the opportunity to take 6 semester credit hours of engineering elective courses. These elective courses will be graduate-level courses primarily from the Klesse College of Engineering and Integrated Design from various departments in areas such as biomedical engineering, civil engineering, computer engineering, electrical engineering, materials engineering, and mechanical engineering.		
Total Credit Hours		**30**

Doctor of Philosophy Degree in Biomedical Engineering

A Doctor of Philosophy degree in Biomedical Engineering (BME) at The University of Texas at San Antonio is offered jointly with The University of Texas Health Science Center at San Antonio. A matrix of academic tracks is offered based on segments of biomedical engineering and/or areas of clinical emphasis. Specifically, the program has emphases in the following areas: biomaterials, biomechanics, and bioimaging. The biological areas covered are orthopedics/dental tissues, cardiovascular systems, and neural systems. The Ph.D. in Biomedical Engineering will be awarded to candidates who have displayed an in-depth understanding of the concepts that are necessary for critically judging the scientific literature, formulating novel hypotheses, designing experimental protocols to test the hypotheses, interpreting their results, and demonstrating their ability to make an original contribution to knowledge in the biomedical field.

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

Students who hold a bachelor's or master's degree may apply to the program. The minimum requirements for admission to the Doctor of Philosophy in Biomedical Engineering degree program are described below. Note that admission is competitive and satisfying these requirements does not guarantee admission.

- Applicants must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science or engineering discipline. All students should have had sufficient background in engineering, chemistry, biology, and physics prior to being admitted to the program. It is expected that these students will have bachelor's degrees with emphasis in either engineering, physical science, or biological science disciplines. All students are required to have completed at least one year of engineering physics, chemistry, biology, and mathematics (up to Differential Equations I or Applied Engineering Analysis I). Students with deficiencies in the above courses will be required to satisfactorily complete selected courses as a condition of acceptance.
- Applicants with a master's degree must have a grade point average of 3.0 or better in their master's degree program. Applicants with a master's degree in Biomedical Engineering or in a related field may apply a maximum of 30 semester credit hours of previously earned graduate credit (except research and thesis hours) toward their doctoral degree. The Committee on Graduate Studies (COGS) will evaluate each student's transcript, and credit will be recommended for transfer on a course-by-course basis to satisfy the formal coursework requirements of the doctoral degree.
- Students whose native language is not English must achieve a university-wide minimum score on the Test of English as a Foreign Language (TOEFL) iBT or the International English Language Testing System (IELTS). The current university-wide minimum score for TOEFL iBT is 79, and IELTS is 6.5. Students are also encouraged to review the Graduate Catalog for any changes in the university-wide minimum scores for TOEFL/IELTS. This test score is waived for international students from countries where English is the official language or for students who have earned an accredited bachelor's degree or higher in the United States or in countries where English is the official language, as indicated in the Graduate Catalog.
- A minimum of two letters of recommendation are required (three are preferred) to attest to the applicant's readiness for graduate study.
- A complete application includes the application form, official transcripts, letters of recommendation, a résumé, English proficiency

test (TOEFL or IELTS) scores if applicable, and a statement of the applicant's research experience, interests, and goals.

Degree Requirements and Program of Study

The Doctor of Philosophy degree in Biomedical Engineering (BME) will consist of at least 82 semester credit hours for students with a bachelor's degree. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. For students with a master's degree, course credit allowed for transfer will be decided on a case-by-case basis by the Biomedical Engineering COGS. If recommended by the COGS, the request will then be submitted to the Dean of the Graduate School for approval. Since this is a joint graduate program, some courses are offered at The University of Texas Health Science Center at San Antonio. To enroll in UT Health San Antonio courses (UT Health San Antonio Catalog (http://catalog.uthscsa.edu/)), students must register through the UT Health San Antonio website (http://www.uthscsa.edu). Any questions concerning registration at UT Health San Antonio should be directed to the BME Program Office at UT Health San Antonio.

Code	Title	Credit Hours
Students with an M.S. degree in Biomedical Engineering will be reviewed on a case-by-case basis. All students who have obtained an M.S. degree in Biomedical Engineering from UT San Antonio are required to complete the following courses:		
CSAT 5095	Experimental Design and Data Analysis (at UT Health San Antonio)	
One prescribed BME elective		
Course requirements in Sections B, D (5 credits), E, and F of doctoral program		

Students matriculating into the doctoral program with a B.S. degree will be required to complete a minimum of 82 hours. The minimum required curriculum for all students is as follows:

Code	Title	Credit Hours
A. Core Courses:		**19**
Required Core Courses offered at UT San Antonio:		
BME 6033	BME Engineering Analysis [1]	
BME 6703	Biomedical Imaging [1,3]	
BME 6803	Experimental Biomechanics [1]	
BME 6903	Biomaterials [1]	
Required Core Courses offered at UT Health San Antonio:		
BIME 6004	Biology for Bioengineers [1,2]	
BIME 6006	Physiology for BME [1,2]	
CSAT 5095	Experimental Design and Data Analysis	
TSCI 5070	Responsible Conduct of Patient-Oriented Clinical Research	
RADI 5015	Physics of Diagnostic Imaging I [1,3]	
[1] Select any four (4) courses to satisfy the core requirements.		
[2] Only one of these courses may be counted toward the core requirements.		
[3] Only one of these courses may be counted toward the core requirements.		
B. Research seminar		**8**
BME 6011 (at UT San Antonio) or BIME 6090 (at UT Health San Antonio) must be registered for during each Fall and Spring semester while in the BME Doctoral program. With the approval of the Program Director, Ph.D. students are not required to register for the seminar if they are in their fifth year of the program as a full-time student and have registered for the Fall and Spring semester seminars during the preceding four years.		
C. A minimum of 9 semester credit hours of elective courses selected from the list below. Courses not on this list may be taken with the approval of the BME Program.		**9**
UT San Antonio Prescribed Elective Courses:		
BME 6043	Critical Thinking and Writing for BME	
BME 6053	Independent Study in Biomedical Engineering (or BME 6051, BME 6052)	
BME 6093	Topics in Biomedical Engineering	
BME 6123	Medical Device Design	
BME 6143	Biomedical Device Development	
BME 6213	Cellular Engineering	
BME 6233	Cardiovascular Bioengineering	
BME 6723	Bioinstrumentations	
BME 6733	Microfabrication and Application	
BME 6743	Biophotonics	
BME 6753	Biosensors: Fundamentals and Applications	
BME 6793	Topics in Image and Signal Processing	
BME 6823	Advanced Biomechanics	
BME 6843	Tissue Mechanics	
BME 6893	Topics in Biomechanics	
BME 6913	Biomaterials II	
BME 6923	Tissue Engineering	
BME 6933	Tissue-Biomaterials Interactions	
BME 6943	Biomaterials and Cell Signaling	
BME 6963	Fundamentals to Polymer Science with Select Biomedical Applications	
ME 5713	Mechanical Behavior of Materials	
NDRB 5433	Systems Neuroscience	
NDRB 5483	Computational Neuroscience	
UT Health San Antonio Prescribed Elective Courses:		
BIME 5091	Independent Study	
CSAT 5022	Interprofessional Human Gross Anatomy	
IBMS 5000	Fundamentals of Biomedical Science	
INTD 5007	Advanced Cell and Molecular Biology	
INTD 6033	Cell Signaling Mechanisms	
MICR 5051	Introduction to Immunology	
PHAR 5013	Principles of Pharmacology	
PHAR 5014	Integrated Physiology and Therapeutics	
RADI 6016	Physics of Diagnostic Imaging II	
RADI 6051	Statistical Parametric Imaging	
D. Supervised Teaching		**1**
A minimum of 1 semester credit hour of Supervised Teaching is required to satisfy the degree's requirement. Students may take up to 3 semester credit hours. (1-3 semester credit hours)		
BIME 6071	Supervised Teaching	
E. Doctoral Research and Dissertation		**12**

A minimum of 12 semester credit hours of Doctoral Research and Doctoral Dissertation are required.		
1. Doctoral Research requires a minimum of 6 semester credit hours.		
BME 7951	Doctoral Research	
BME 7952	Doctoral Research	
BME 7953	Doctoral Research	
BME 7956	Doctoral Research	
BIME 6097	Research	
2. Doctoral Dissertation requires a minimum of 6 semester credit hours.		
BME 7991	Doctoral Dissertation	
BME 7992	Doctoral Dissertation	
BME 7993	Doctoral Dissertation	
BME 7996	Doctoral Dissertation	
BIME 7099	Dissertation	
F. Electives		**33**
Select a maximum of 33 semester credit hours of electives.		
The remainder of the hours can be BME-approved graduate level courses or research credits.		
Students in the program must complete at least 82 semester credit hours for graduation. The entire program of study must be recommended by the student's Dissertation Advisor, Dissertation Committee, and COGS and must be submitted to the Dean of the Graduate School for final approval. The courses taken by students are intended to focus and support the individual's mastery of their particular area of specialization.		
Total Credit Hours		**82**

Advancement to Candidacy

All students seeking a doctoral degree must be admitted to candidacy after passing a doctoral qualifying examination. Students should consult Doctoral Degree Regulations in this catalog for the other pertinent requirements.

Satisfactory Performance on the Doctoral Qualifying Examination for Admission to Candidacy

The qualifying examination will be administered before the student commences the chosen dissertation research. This examination will be comprehensive in nature and may be written, oral, or both. Topics covered will include not only information provided in courses taken by the student but also basic knowledge necessary for research in the student's chosen area of study. The Committee on Graduate Studies (COGS) will determine the format of the examination and the composition of the Qualifying Examination Committee (QEC), with the provision that BME faculty from both UT San Antonio and UT Health San Antonio will be included. The QEC will administer the examination, evaluate the student's performance, and report its judgment to the Committee on Graduate Studies. A student is allowed to take the qualifying examination twice. Admission to candidacy will be contingent on passing the qualifying examination. Students who do not pass the qualifying examination may be accommodated with a terminal Master's degree after completing additional prescribed courses and/or research approved by the Supervising Professor, Program Director, and the COGS.

Doctoral Dissertation

A dissertation, which is an original contribution to scholarship, based on independent investigation (doctoral research) in the major area, is required of every candidate. The doctoral research will be conducted by the student under the guidance of the Supervising Professor and the advice of the Dissertation Committee. Prior to starting the doctoral research, each student will submit a dissertation proposal to the COGS for approval. The doctoral dissertation will be the responsibility of the student and the Supervising Professor. Registration for dissertation credit hours must be for a period of more than one semester. During each semester that a student receives advice and/or assistance from a faculty member or supervision by the Dissertation Committee or uses UT San Antonio or UT Health San Antonio resources, he or she will be required to enroll for credit in the appropriate dissertation course. The form and format of the dissertation should follow the guidelines and rules already in effect at UT San Antonio or UT Health San Antonio.

Composition of the Dissertation Committee

The Dissertation Committee is made up of at least five members. The committee should consist of the Supervising Professor, one BME Graduate Faculty member from UT San Antonio, one BME Graduate Faculty member from UT Health San Antonio, one member of the graduate faculty outside of the BME Graduate Faculty from either UT San Antonio or UT Health San Antonio, and one member from outside both institutions. In addition, there is a minimum of 50 percent dissertation committee membership from UT San Antonio for students with a Supervising Professor from UT San Antonio. The student's dissertation proposal and the proposed composition of the Dissertation Committee will be evaluated and approved by the COGS.

Final Oral Examination (Defense of Dissertation)

A satisfactory final oral examination is required for the approval of a dissertation. Acceptance of the dissertation will be contingent upon approval of the respective Dissertation Committee.

The dissertation defense will consist of a seminar presentation by the candidate to the general public. A closed door examination by the Dissertation Committee follows and covers the general field of the dissertation and other parts of the student's program as determined by the respective committee. Members of the Dissertation Committee must be satisfied that the student has:

1. Completed the research approved by the Dissertation Committee.
2. Passed all examinations required by the COGS, including the successful defense of the dissertation.
3. Completed the required coursework.
4. Completed a dissertation that is an independent investigation in the biomedical engineering field and constitutes a contribution to the respective discipline.
5. Submitted an abstract for publication in Dissertation Abstracts International that meets with the approval of University requirements.

Upon successful completion of the aforementioned requirements, the Dissertation Committee members will sign the approval forms for the doctoral dissertation and make an official recommendation to the Graduate School of Biomedical Sciences at UT Health San Antonio or to the Graduate School at UT San Antonio that the Doctoral degree be awarded.

Students should note that the above is a summary of the requirements for the Doctoral degree and are advised to consult the University (UT San Antonio) Doctoral Degree Regulations as well as the BME Student Handbook, which contains details specific to the UT San Antonio/UT Health San Antonio Joint Graduate Program in Biomedical Engineering.

Doctor of Philosophy Degree in Chemical Engineering

The Department of Biomedical Engineering and Chemical Engineering offers opportunities for advanced studies and research leading to the Doctor of Philosophy (Ph.D.) degree in Chemical Engineering. The Ph.D. in Chemical Engineering will be awarded to candidates who have displayed an in-depth understanding of the concepts that are necessary for critically judging the scientific literature, formulating novel hypotheses, designing experimental protocols to test hypotheses, interpreting their results, and demonstrating the ability to make an original contribution to knowledge in their field of specialty.

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

Students who hold a bachelor's or master's degree may apply to the program. The minimum requirements for admission to the Doctor of Philosophy in Chemical Engineering degree program are described below. Note that admission is competitive and satisfying these requirements does not guarantee admission.

In addition to satisfying the University-wide graduate admission requirements, applicants must:

- Hold a bachelor's or master's degree in Chemical Engineering or a related field. The degree must be from an accredited institution. If the degree of an applicant is in an area other than Chemical Engineering, they may be required to take foundation courses. Successful Chemical Engineering Ph.D. candidates must have a minimum Grade Point Average (GPA) of 3.0 in upper-division and graduate courses.
- Submit official transcripts.
- Non-native English speakers must take the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS). TOEFL minimum scores are 79 or 550 for Internet or paper versions, respectively. IELTS minimum score is 6.5.
- Submit two letters of recommendation from persons familiar with the applicant's academic potential.
- Submit a statement of research/specialization interest.
- Submit a résumé/curriculum vita.

Degree Requirements and Program of Study

Students will be able to enter the program directly following completion of a bachelor's degree. These students will be required to take a minimum of **72 credit hours** in order to graduate. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. Full-time status for a graduate student is **9 credit hours** per semester. UT San Antonio's Graduate School allows up to 30 credit hours to be transferred from an accredited master's program.

Based on these requirements, students entering with a master's degree will be required to complete a minimum of 42 credit hours. Students in the program will need to complete the following required coursework: 4 core courses (12 credit hours) and Research Seminar (4 credit hours). The remainder of the credit hours (56 credit hours) can be distributed as: in-depth elective courses (a minimum of 9 credit hours) related to their specific research, Doctoral Research (a minimum of 18 credit hours), and Doctoral Dissertation (a minimum of 18 credit hours). Students can complete a one-semester internship in a non-academic R&D center for credit. Students are expected to take all core and required chemical engineering courses before the end of the fourth semester. The seminar course must be taken every semester for the first two years in the Ph.D. program. The elective courses will be taken as suggested by the student's research advisor.

Transfer of Credit

Transfer of credit from other institutions is possible under the following regulations:

1. Transfer of credit for core classes is granted only if the syllabi of the classes adhere to the standard of the syllabi used for the core classes in the current program and typically is allowed only from institutions that grant Ph.D. degrees in Chemical Engineering.
2. A maximum of 30 semester credit hours is allowed to be transferred, excluding research and thesis hours, and must adhere to the Transfer of Credit policy under Doctoral Degree regulations in the UT San Antonio Graduate Catalog.
3. No research hours can be transferred to the program.

The required curriculum for the Ph.D. in Chemical Engineering is as follows:

Code	Title	Credit Hours
A. Core Courses		**12**
CME 6103	Chemical Engineering Kinetics and Reactor Design	
CME 6203	Advanced Chemical Engineering Thermodynamics	
CME 6303	Transport Phenomena	
CME 6403	Mathematical Methods in Chemical Engineering	
B. Research Seminar		**4**
CME 6601	Chemical Engineering Research Seminar (repeated)	
The seminar course must be taken every semester for the first two years in the program.		
C. Prescribed Elective Courses		**9-20**
A minimum of 9 semester credit hours must be selected from the list below:		
Chemical Engineering electives		
CME 5503	Chemical Engineering Ethics and Leadership	
CME 6113	Heterogeneous Catalysis and Surface Science	
CME 6123	Electrochemical Engineering	
CME 6133	Biochemical Engineering	
CME 6703	Electronic and Local Atomic Structure using Synchrotron Methods	
CME 6803	Introduction to Polymer Science and Engineering	
CME 6813	Self-healing Polymers	
CME 6903	Fundamentals of Interfaces, Nanoparticles, and other Colloids	
CME 6943	Chemical Engineering Internship	
CME 6953	Independent Study in Chemical Engineering	
or CME 6951	Independent Study in Chemical Engineering	
or CME 6952	Independent Study in Chemical Engineering	

CME 6973	Topics in Chemical Engineering
Other electives	
BME 6033	BME Engineering Analysis
BME 6043	Critical Thinking and Writing for BME
BME 6093	Topics in Biomedical Engineering
BME 6123	Medical Device Design
BME 6213	Cellular Engineering
BME 6303	Introduction to Python with Applications to Biomedical Industries
BME 6403	Biomedical Terminologies for Entrepreneurs
BME 6703	Biomedical Imaging
BME 6743	Biophotonics
BME 6803	Experimental Biomechanics
BME 6843	Tissue Mechanics
BME 6893	Topics in Biomechanics
BME 6903	Biomaterials
BME 6933	Tissue-Biomaterials Interactions
BME 6963	Fundamentals to Polymer Science with Select Biomedical Applications
CE 5613	Environmental Chemistry
CE 5623	Advanced Treatment Processes for Water Quality Control
CE 5643	Sustainable Energy Systems
CE 5733	Special Topics in Environmental Engineering
CE 6383	Global Change
or ES 5043	Global Change
CE 6603	Fate and Transport of Contaminants in the Environment
CHE 6973	Special Problems
ES 5063	Environmental Microbiology
MATE 5103	Principles of Materials Engineering: Fundamentals of Structure, Chemistry, and Physical Properties
MATE 5113	Functions, Evaluations and Synthesis Technology of Advanced Materials
MATE 5213	Sensing and Sensor Materials
MATE 5223	Structure-Chemistry-Property Relations in Materials Science and Engineering
MATE 5253	Magnetic Materials and Electromagnetic Engineering
ME 5233	Advanced Quality Control
ME 5273	Alternative Energy Sources
ME 5453	Advanced Strength of Materials
ME 5473	Viscoelasticity
ME 5483	Finite Element Methods
ME 5503	Lean Manufacturing and Lean Enterprises
ME 5643	Green and Sustainable Manufacturing and Enterprise Systems
ME 5653	Computational Fluid Dynamics
ME 5743	Composite Materials
ME 6413	Elasticity
D. Doctoral Research and Dissertation	**36-47**

1. Doctoral Research (minimum of 18 semester credit hours required):

CME 7101	Doctoral Research
CME 7102	Doctoral Research
CME 7103	Doctoral Research
CME 7106	Doctoral Research

2. Doctoral Dissertation (minimum of 18 semester credit hours required):

CME 7201	Doctoral Dissertation
CME 7202	Doctoral Dissertation
CME 7203	Doctoral Dissertation
CME 7206	Doctoral Dissertation

Total Credit Hours **72**

Advancement to Candidacy

All students seeking a doctoral degree must be admitted to candidacy after passing a doctoral qualifying examination. Students should consult Doctoral Degree Regulations in this catalog for the other pertinent requirements.

The following describes the Chemical Engineering Ph.D. program examination steps required for the advancement to the Ph.D. candidacy, the dissertation, and its final defense examination.

Oral Comprehensive Examination

Students must take their oral comprehensive examination within four long semesters of entering the program. The oral comprehensive examination is a dissertation proposal defense and will also serve as a qualifying exam. The dissertation proposal should describe the topic, the literature review, the proposed methodology, and experimental approach, as well as highlight the novelty and potential contribution of the topic to the scientific field. The student's Dissertation Committee will consist of a chair from the faculty, approved to supervise Chemical Engineering dissertation work; two additional faculty from the department; one UT San Antonio faculty member from outside the department; and one external member. No more than two attempts to pass the comprehensive examination are permitted. The results of the comprehensive examination are reported to the GSC and the Dean of the Graduate School.

Upon successful completion of the comprehensive examination, students advance to the Ph.D. candidacy and are allowed to take Doctoral Dissertation credit hours.

Dissertation

Candidates must demonstrate their ability to conduct independent research by completing an original dissertation. The Dissertation Committee guides, critiques, and finally approves the candidate's dissertation. The format of the dissertation must follow the doctoral degree regulations of the Graduate School as documented under the most recent Graduate Catalog.

Final Oral Dissertation Defense

The final oral defense consists of a public presentation of the dissertation work by the Doctoral candidate, followed by a question/answer period by his/her Dissertation Committee. The student must notify the Graduate School in writing two weeks prior to the final scheduled oral defense. Results of the oral defense are reported to the Dean of the Graduate School. Awarding of the degree is based on the approval of the candidate's Dissertation Committee and the recommendation of the Dean

of the Graduate School, who certifies the completion of all University-wide requirements.

- Graduate Certificate in Engineering Education (p. 13)
- Graduate Certificate in Medical Device Commercialization (p. 13)

Graduate Certificate in Engineering Education

The Graduate Certificate in Engineering Education is a 9-semester-credit-hour program offered as a collaborative effort between the Klesse College of Engineering and Integrated Design and the College of Education and Human Development. The program will have an emphasis on engineering curriculum development, instruction, and assessment methods to support student learning outcomes. It covers history and attributes of different engineering fields. The proposed program also promotes the integration of mathematics and science in the context of engineering.

This program is targeted for both engineering students wishing to prepare as future engineering instructors in a college or university and for teachers in the field (or future teachers) interested in preparing to teach engineering at the middle and high school level in formal and informal educational settings. It provides a training platform for those educators who plan to teach engineering or pre-engineering subjects. This unique program also allows for the collaboration of students and faculty from both technical and educational fields as peers.

Program Objectives

The Graduate Certificate in Engineering Education will inspire engineering educators at all levels to succeed and excel in the following ways:

Objective 1: To advance the development of innovative approaches to engineering education.

Objective 2: To provide access and opportunity for engineering educators to improve their teaching skills and classroom management.

Objective 3: To promote a broad and diverse community of engineering educators that engages all members to share new ideas and best practices.

Admission Requirements

Applicants with a bachelor's degree in an engineering, sciences, or education discipline may apply to the certificate program.

A minimum grade point average (GPA) of 3.0 for the last two years of work toward the bachelor's degree is required.

To maintain enrollment in the certificate program, students must maintain a 3.0 GPA throughout their tenure in the program.

Certificate Program Requirements

To meet the curricular requirements for the Graduate Certificate in Engineering Education, students must complete 9 semester credit hours as indicated below. Courses may be taken in any order.

Code	Title	Credit Hours
EGR 6183	Engineering Education Methods	3
EGR 6283	Mentored Teaching in Engineering	3
EGR 6973	Special Problems: Becoming an Engineering Educator	3
or CI 6973	Special Problems	
Total Credit Hours		**9**

Graduate Certificate in Medical Device Commercialization

The Graduate Certificate in Medical Device Commercialization (MDC) is administered by the Department of Biomedical Engineering and Chemical Engineering in the Klesse College of Engineering and Integrated Design. This certificate is for students who are interested in gaining entry into the biomedical industry workforce. The MDC graduate certificate will be awarded to candidates who have satisfactorily completed all the requirements for the program and are in good academic standing.

The certificate is also offered in a 100 percent online format. Students pursuing the 100 percent online format must fulfill all degree requirements in the same manner as residential students.

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

Admission Requirements

Undergraduate and graduate students who are currently enrolled in an engineering, science, or business discipline, or those who hold a bachelor's degree in one of these areas, may apply to the certificate program. The minimum requirements for admission to the Graduate Certificate in Medical Device Commercialization program are described below. Note that satisfying these requirements does not guarantee admission.

- All applicants (graduate and undergraduate students) must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science, engineering, or business discipline. Students with deficiencies in the above courses will be required to satisfactorily complete selected courses as a condition of acceptance.
- Current undergraduate students must be in the final three semesters of their program and must have a grade point average of 3.0 or better in their discipline. Students may only register for 6 semester credit hours of the certificate courses, and these courses should not be counted toward their undergraduate degree. The final 6 semester credit hours required for the award of the certificate should be taken after completing their undergraduate program.
- Current undergraduate or graduate students must be in good academic standing, that is, having a grade point average of 3.0 or better.
- Applicants who have already completed their undergraduate degree, are currently not in a graduate program, and are not working in the medical device industry must have a grade point average of 3.0 or better in the last 60 semester credit hours of coursework with a major in a recognized science, engineering, or business discipline. Students with a borderline grade point average (between 2.9 and 3.0) will be required to satisfactorily complete selected courses as a condition of acceptance.
- Applicants who are currently employed in the medical device industry and do not meet the 3.0 grade point average needed for admission will have their work experience taken into account. A 0.5 grade point average credit will be applied to students for every full-time year of experience in the medical device industry. For example, if a candidate has a 2.0 grade point average with two years of industry experience,

the grade point average will be considered to be 3.0 (given the two years of work experience) at the time of application.

- Graduate Record Examination (GRE) or Graduate Management Admission Test (GMAT) scores are not required for admission consideration.
- A minimum of one letter of recommendation attesting to the applicant's readiness for this certificate program is required.
- Students whose native language is not English must achieve a university-wide minimum score on either the Test of English as a Foreign Language (TOEFL) iBT or the International English Language Testing System (IELTS). The current university-wide minimum score for TOEFL iBT is 79, and IELTS is 6.5. Students are encouraged to review the Graduate Catalog for any changes in the university-wide minimum scores for TOEFL/IELTS. Note that TOEFL/IELTS scores older than two years are not valid or accepted. This test score is waived for international students from countries where English is the official language or for students who have earned an accredited bachelor's degree or higher in the United States or in countries where English is the official language, as indicated in the Graduate Catalog.

A complete application includes the application form, official transcripts, letter(s) of recommendation, and English Proficiency test (TOEFL or IELTS) scores, if applicable.

Certificate Program Requirements

The Graduate Certificate in Medical Device Commercialization consists of at least 12 semester credit hours beyond the bachelor's degree. Undergraduate courses, general education courses, and prerequisites for graduate courses cannot be counted toward this total. For transferring students, course credit allowed for transfer will be decided on a case-by-case basis by the program director and the admissions committee for this certificate program. If recommended by the program director and admissions committee, the request will then be submitted to the Dean of the Graduate School for approval. The required curriculum for all students is as follows:

Code	Title	Credit Hours
12 hours of coursework chosen from the following, in consultation with your graduate advisor:		12
BME 6213	Cellular Engineering	
BME 6143	Biomedical Device Development	
BME 6153	Medical Device Project Management	
BME 6073	Professional Science Master's Practicum [1]	
BME 6133	Biomedical Project	
BME 6163	Medical Technology Regulatory	
BME 6173	Biomedical Commercialization and Entrepreneurship	
BME 6303	Introduction to Python with Applications to Biomedical Industries	
BME 6723	Bioinstrumentations [2]	
BME 6953	Biomaterials for Drug Delivery/ Pharmacology	
Total Credit Hours		**12**

[1] Students currently working in the biomedical industry or undertaking biomedical industry experiences have the option to request experiential credits using a competency-based exam. Students will have to register for BME 6073 and must submit a written request to take the competency-based exam. Three (3) semester credit hours will be award for the course upon passing the competency-based exam. The administration of the exam and the period of experiences needed to qualify for the exam will be the responsibility of the program director.

[2] One of BME 6203, BME 6723, or BME 6953 can be taken as a specialization elective if desired to fit industry-specific technical competency. Students can only count one of these courses toward the certificate program.

Biomedical Engineering (BME) Courses

BME 6011. Research Seminar. (1-0) 1 Credit Hour.
Prerequisite: Graduate student standing; consent of the instructor and the Graduate Advisor of Record. The seminar coordinator may require students to present their research. May be repeated for credit. The grade report for the course is either "CR" (satisfactory performance) or "NC" (unsatisfactory performance). (Formerly BME 5011 and BME 6991. Same as BIME 6090 at UT Health San Antonio.) This course has Differential Tuition.

BME 6021. Supervised Teaching. (0-0) 1 Credit Hour.
Prerequisite: Doctoral student standing; consent of the instructor and the Graduate Advisor of Record. Supervised teaching of undergraduate or graduate students will be required for at least one semester. Students may be required to lecture at undergraduate courses or graduate courses in the field of their expertise. Students will work with the instructor of the course or with their research supervisor on the number of classes to be taught. (Same as BIME 6071 at UT Health San Antonio.) This course has Differential Tuition.

BME 6022. Supervised Teaching. (0-0) 2 Credit Hours.
Prerequisite: Doctoral student standing; consent of the instructor and the Graduate Advisor of Record. Supervised teaching of undergraduate or graduate students will be required for at least one semester. Students may be required to lecture at undergraduate courses or graduate courses in the field of their expertise. Students will work with the instructor of the course or with their research supervisor on the number of classes to be taught. (Same as BIME 6071 at UTHSCSA.) This course has Differential Tuition.

BME 6023. Supervised Teaching. (0-0) 3 Credit Hours.
Prerequisite: Doctoral student standing; consent of the instructor and the Graduate Advisor of Record. Supervised teaching of undergraduate or graduate students will be required for at least one semester. Students may be required to lecture at undergraduate courses or graduate courses in the field of their expertise. Students will work with the instructor of the course or with their research supervisor on the number of classes to be taught. (Same as BIME 6071 at UTHSCSA.) This course has Differential Tuition.

BME 6033. BME Engineering Analysis. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in engineering or consent of the instructor. This course is designed to introduce students to advanced mathematical and numerical methods necessary to solve problems frequently encountered in biomedical engineering. Topics covered include vector differential and integral calculus, linear algebraic equations, and ordinary and partial differential equations. (Same as EGR 6013 and ME 6013. Same as BME 6093 offered in Fall 2007. Credit can be earned for only one of the following: BME 6033, BME 6093 taken Fall 2007, EGR 6013, or ME 6013.) This course has Differential Tuition.

BME 6043. Critical Thinking and Writing for BME. (3-0) 3 Credit Hours.
Prerequisite: Doctoral students who are either taking their qualifying examinations or have been admitted to candidacy; consent of the instructor and of the Graduate Advisor of Record. This course introduces students to grant applications and manuscript writing, and provides the opportunity to learn through writing and critiquing research proposals, manuscripts, abstracts, and scientific presentations. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6051. Independent Study in Biomedical Engineering. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing; consent of the instructor and of 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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours, regardless of discipline, will apply toward the degree. This course has Differential Tuition.

BME 6052. Independent Study in Biomedical Engineering. (0-0) 2 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor and of 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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours, regardless of discipline, will apply toward the degree. This course has Differential Tuition.

BME 6053. Independent Study in Biomedical Engineering. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor and of 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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours, regardless of discipline, will apply toward the degree. This course has Differential Tuition.

BME 6063. Introduction to Scientific Computing and Visualization. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor. This is an introductory course covering the basic concepts and tools of scientific computing and visualization. It will cover basic UNIX operations (shell scripts and editors), UNIX tools (grep, awk, sed), basic visualization concepts and software tools (ParaView and VisIt). It will also cover parallel programming using Fortran/C/C++ with Message Passing Interface (MPI) and public domain libraries. (Credit can be earned for only one of the following: BME 6063, ME 4953 or ME 5013.) This course has Differential Tuition.

BME 6073. Professional Science Master's Practicum. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing and consent of the Program Director. An internship in a Biomedical Engineering company. Students must have completed all required core courses and electives, and be in the writing phase of their thesis. May not be repeated for credit. This course has Differential Tuition.

BME 6093. Topics in Biomedical Engineering. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor and of the Graduate Advisor of Record. May be repeated for credit on a different topic of study. This course has Differential Tuition.

BME 6103. Biology for Bioengineers. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor and of the Graduate Advisor of Record. This course provides a broad background in biological concepts with specific attention given to biological processes important to bioengineering. Topics may include biochemistry, genetics, molecular biology, cell biology, and physiology. (Same as BIME 6004 at UT Health San Antonio. Credit cannot be earned for both BME 6103 and BIME 6004.) This course has Differential Tuition.

BME 6123. Medical Device Design. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing; consent of the instructor and of the Graduate Advisor of Record. This course will educate students about current biomedical technologies and product development. Topics covered will include ideation, concept development, design methodologies, business plan basics, regulatory concepts for medical devices, and intellectual property management. This course has Differential Tuition.

BME 6131. Biomedical Project. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing; consent of the instructor and of the Graduate Advisor of Record and concurrent enrollment in BME 6143. This project course will be offered to students performing well-defined engineering design projects, including the design and development of a biomedical device, program, and/or instrument. It can be used by nonthesis students as an alternative to the comprehensive examination. This course requires the final presentation of a prototype at the end of the semester and cannot be repeated for credit. The grade report for the course is either "CR" (satisfactory performance in Biomedical Project) or "NC" (unsatisfactory performance in Biomedical Project). (Credit cannot be earned for both BME 6131 and BME 6961.) This course has Differential Tuition.

BME 6133. Biomedical Project. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing, consent of the instructor and of the Graduate Advisor of Record and concurrent enrollment in BME 6143. This project course will be offered to students performing well-defined engineering design projects, including the design and development of a biomedical device, program, and/or instrument. It can be used by non-thesis students as an alternative to the comprehensive examination. This course requires the final presentation of a prototype at the end of the semester and cannot be repeated for credit. The grade report for the course is either "CR" (satisfactory performance in Biomedical Project) or "NC" (unsatisfactory performance in Biomedical Project). This course has Differential Tuition.

BME 6143. Biomedical Device Development. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing, consent of the instructor and of the Graduate Advisor of Record, and BME 6123. This course involves the development of project proposals, testing of the design project and presentation of conceptual designs and a final prototype. Industrial collaboration and/or faculty sponsorship of these projects is encouraged. This course has Differential Tuition.

BME 6153. Medical Device Project Management. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. This course addresses concepts and techniques for the management of business and technology projects. Includes topics such as the project life cycle, project planning, project scheduling, project cost estimating, project risk analysis, project control techniques, earned value management, project organizations and functions, project manager responsibilities, and team building. This course has Differential Tuition.

BME 6163. Medical Technology Regulatory. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing, consent of the instructor and of the Graduate Advisor of Record, and BME 6123. This course provides an overview of product quality and safety responsibilities during device development, the regulatory framework, both nationally as well as internationally, and product monitoring standards. An understanding of the approval submission process and the nature of benchmarking and testing products as well as product classifications will be covered. This course has Differential Tuition.

BME 6173. Biomedical Commercialization and Entrepreneurship. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing, consent of the instructor and of the Graduate Advisor of Record, and BME 6123. A review of the steps and processes involved in starting a biomedical technology-based commercial endeavor. The focus is built around the steps of identifying a problem area, identifying potential technological solutions to the identified need, and developing a proposed business entity to commercialize the technology solution. This course has Differential Tuition.

BME 6203. Physiology for Engineers. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor or completion of BIME 6004 (UT Health San Antonio). Designed to provide students with the essential graduate-level background for applications and practices of biomedical engineering. Integration of the nervous, skeletal, muscle, cardiovascular, and other systems from the sub-cellular to the whole-organism level will be emphasized. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6213. Cellular Engineering. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor and completion of BIME 6004 (UT Health San Antonio) or BME 6203. This course will focus on the use of engineering skills and principles in the analysis and design of cellular function including protein engineering, enzyme kinetics, drug design, receptor-ligand interactions, cell signaling, metabolism, growth, adhesion and migration. This course has Differential Tuition.

BME 6233. Cardiovascular Bioengineering. (3-0) 3 Credit Hours.
Prerequisite: BME 2103, BME 6203, and BME 6033 or consent of the instructor. This course introduces the bioengineering principles applied to the understanding and modeling of the cardiovascular system. Topics covered include anatomy of the human cardiovascular system; comparative anatomy; allometric scaling principles; cardiovascular molecular and cell biology; overview of continuum mechanics; form and function of blood, blood vessels, and the heart from an engineering perspective; normal, diseased and engineered replacement tissues and medical devices. This course has Differential Tuition.

BME 6303. Introduction to Python with Applications to Biomedical Industries. (3-0) 3 Credit Hours.
Students will be exposed to coding for applications using Python in the biomedical industries. The course aims to provide students with the ability to apply Python to analyze biological data and solve contemporary problems in the biosciences, bioengineering and biomedicine. This course has Differential Tuition.

BME 6313. Computational Bioengineering and Biomedicine. (3-0) 3 Credit Hours.
Prerequisite: BME 6033 or consent of the instructor. The objective of this course is to provide both engineering and medical students an introductory knowledge and skills of mathematical modeling and computer simulation, particularly in bioengineering. The course will consist of three parts: theoretical background, computational methods, and practical applications. (Same as ME 6873. Credit cannot be earned for both BME 6313 and ME 6873.) This course has Differential Tuition.

BME 6403. Biomedical Terminologies for Entrepreneurs. (3-0) 3 Credit Hours.
Prerequisite: Completion of or concurrent enrollment in BME 6123. Designed to provide students with an introduction to concepts and terminologies that span across the fields of biomedical engineering, technologies, medical devices and healthcare. This course has Differential Tuition.

BME 6413. Working Knowledge in the Biomedical Industries. (3-0) 3 Credit Hours.
Prerequisite: Completion of or concurrent enrollment in BME 6403. Designed to provide students with an introduction to biomedical industries and medical product categories. Examples will be provided for specific companies in regards to the technologies, intellectual property protection and business models that provide the foundation for their success. This course has Differential Tuition.

BME 6593. Biomaterials for Drug Delivery/Pharmacology. (3-0) 3 Credit Hours.
Provides a conceptual understanding of therapeutic agents used to regulate physiological function of cells comprising organ systems with relevance to biomaterials. Interpretation of drug mechanisms at a molecular, cellular and tissue level. Traditional reviews of pharmacodynamics and pharmacokinetics will be addressed with particular application to biomaterial interaction and drug-delivery systems. This course has Differential Tuition.

BME 6703. Biomedical Imaging. (3-0) 3 Credit Hours.
Prerequisite: Consent of the BME Program Director. This course will examine, from a systems perspective, the techniques used in a variety of medical imaging modalities, which include X-ray imaging, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine (PET), ultrasound imaging, optical imaging and photoacoustic imaging. The fundamental principles and engineering underlying each imaging modality will be discussed and a performance analysis of each system will be examined. With approval from the BME Program Director, credit for this course can be counted towards satisfying the imaging core course for Ph.D. students. (Credit can be earned for only one of the following: BME 6703 or RADI 5015 at UT Health San Antonio.) This course has Differential Tuition.

BME 6723. Bioinstrumentations. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. This course will cover fundamental principles of bioinstrumentation used in clinical and research measurements. Topics include: principles of transducer operation, amplifiers and signal processing, recording and display. Overview of specific examples in optical sensors, biological sensors, MRI, ultrasound, pacemakers and defibrillators. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6733. Microfabrication and Application. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. This course describes the science of miniaturization which is essential for nanotechnology development. Microfabrication techniques for micro-electro-mechanical systems (MEMS), bioMEMS, microfluidics, and nanomaterials and their applications in biomedical research will be covered. This course has Differential Tuition. Course Fee: STSE $30; LRE1 $25.

BME 6743. Biophotonics. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. This course describes the fundamental principles of biophotonics and their wide range of applications in biomedical research. Topics will include fundamentals of light interactions with molecules, cells, and tissues, optical biosensing (fiber-optic biosensors, evanescent wave biosensors, surface plasmon resonance biosensors), optical imaging (transmission microscopy, fluorescence microscopy, confocal scanning microscopy, multiphoton microscopy, fluorescence lifetime imaging microscopy), flow cytometry, photodynamic therapy, laser tweezers and laser scissors, and nanotechnology for biophotonics. This course has Differential Tuition.

BME 6753. Biosensors: Fundamentals and Applications. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. This course will cover biosensing basics and in-depth view of device design and performance analysis. Topics include optical, electrochemical, acoustic, piezoelectric, and nano-biosensors. Emphasized applications in biomedical, environmental, and homeland security areas are discussed. This course has Differential Tuition.

BME 6793. Topics in Image and Signal Processing. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. May be repeated for credit on a different topic of study. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6803. Experimental Biomechanics. (3-0) 3 Credit Hours.
Prerequisite: BME 6033 and graduate standing. Fundamental applications of engineering mechanics in studying and modeling fluid flow, tissues, organs, and the whole human body will be discussed. This course includes a laboratory. (Formerly BME 6833. Same as ME 6833. Credit can be earned for only one of the following: BME 6803, BME 6833, ME 5833, or ME 6833. Formerly titled "Biomechanics I.") This course has Differential Tuition.

BME 6823. Advanced Biomechanics. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing. This course covers biomechanics of biological tissue deformation and their constitutive equations. Topics may include elasticity, viscoelasticity, deformation, stress analysis, strain measurement, stress and strain in organs. Tissues covered may include heart, blood vessels, cartilage, and bone. (Formerly titled "Biomechanics II.") This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6843. Tissue Mechanics. (3-0) 3 Credit Hours.
Prerequisite: BME 6803 or ME 3663 or consent of the instructor. Topics may include biomechanics characterization, modeling, and properties of regenerating tissues ranging from bone, cartilage, tendons, ligaments, skin, adipose tissue, nerves, bladder, eye, and pulmonary and cardiovascular tissues. This course has Differential Tuition.

BME 6893. Topics in Biomechanics. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. May be repeated for credit on a different topic of study. (Same as ME 6893. Credit cannot be earned for both BME 6893 and ME 6893 when the topic is the same.) This course has Differential Tuition.

BME 6903. Biomaterials. (3-0) 3 Credit Hours.
Prerequisite: Consent of the instructor. Fundamentals of biomaterials science and engineering principles and concepts in repairing, replacing, and protecting human tissues and organs will be discussed. (Formerly BME 5903 and BME 6813. Same as ME 6813. Credit can be earned for only one of the following: BME 5903, BME 6903, BME 6813, ME 5813 or ME 6813.) This course has Differential Tuition.

BME 6913. Biomaterials II. (3-0) 3 Credit Hours.
Prerequisite: BME 6903 and consent of the instructor. Application of biomaterials in medicine and dentistry will be emphasized. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6923. Tissue Engineering. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing. This course is an introduction to the principles and current practice of tissue engineering endeavors. Strategies for choosing and using mammalian cells and scaffold biomaterials as well as select chemical and biophysical stimuli in order to obtain neotissue formation are reviewed in detail. Case studies are discussed to illustrate successful tissue engineering solutions of clinical problems pertinent to tissue regeneration. (Formerly BME 5923 and BME 6853. Credit can be earned for only one of the following: BME 5923, BME 6853, or BME 6923.) This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6933. Tissue-Biomaterials Interactions. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing. This course is an introduction to biocompatibility with special emphasis on the interaction of proteins, cells and tissues with biomaterials. Blood-material interactions are reviewed in detail. Case studies of implants are discussed to illustrate biomaterial selection as a key aspect to successful design of implant materials and prosthetic devices. This course has Differential Tuition.

BME 6943. Biomaterials and Cell Signaling. (2-3) 3 Credit Hours.
Prerequisite: Graduate standing. Develop current understanding of topics in cell receptors and signaling mechanisms with application for biomaterial design. Focus will emphasize receptor-ligand communication, methods of identification and quantification, and pathways involved for cell to material stress response. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

BME 6953. Biomaterials for Drug Delivery/Pharmacology. (3-0) 3 Credit Hours.
Prerequisite: Completion of or concurrent enrollment in BME 6403. Provides a conceptual understanding of therapeutic agents used to regulate physiological function of cells comprising organ systems with relevance to biomaterials. Interpretation of drug mechanisms at a molecular, cellular and tissue level. Traditional reviews of pharmacodynamics and pharmacokinetics will be addressed with particular application to biomaterial interaction and drug-delivery systems. This course has Differential Tuition.

BME 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Approval of the Biomedical Engineering Committee on Graduate Studies to take the Comprehensive Examination. Independent study course for the purpose of taking the Comprehensive Examination for M.S. students in the nonthesis option. May be repeated once if approved by the Biomedical Engineering Committee on Graduate Studies and if the student received an "unsatisfactory performance" on his/her previous attempt on the Comprehensive Examination. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). (Credit cannot be earned for both BME 6961 and BME 6131.) This course has Differential Tuition.

BME 6963. Fundamentals to Polymer Science with Select Biomedical Applications. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing and BME 6903; or consent of the instructor. This course introduces the fundamentals of polymer chemistry, characterization of the chemical and material properties, and determination of the biocompatibility of polymer formulations. Current applications of polymeric biomaterials in diagnostic and therapeutic devices, implants, tissue engineering and regenerative medicine are highlighted and discussed in detail. This course has Differential Tuition.

BME 6981. Master's Thesis Research. (0-0) 1 Credit Hour.
Prerequisite: Master's student standing, and consent of the instructor and of the Graduate Advisor of Record. May be repeated for a maximum of 9 credit hours. (Same as BIME 6098 at UT Health San Antonio.) This course has Differential Tuition.

BME 6982. Master's Thesis Research. (0-0) 2 Credit Hours.
Prerequisite: Master's student standing, and consent of the instructor and of the Graduate Advisor of Record. May be repeated for a maximum of 9 credit hours. (Same as BIME 6098 at UT Health San Antonio.) This course has Differential Tuition.

BME 6983. Master's Thesis Research. (0-0) 3 Credit Hours.
Prerequisite: Master's student standing, and consent of the instructor and of the Graduate Advisor of Record. May be repeated for a maximum of 9 credit hours. (Same as BIME 6098 at UT Health San Antonio.) This course has Differential Tuition.

BME 6986. Master's Thesis Research. (0-0) 6 Credit Hours.
Prerequisite: Master's student standing, and consent of the instructor and of the Graduate Advisor of Record. May be repeated for a maximum of 9 credit hours. (Same as BIME 6098 at UT Health San Antonio.) This course has Differential Tuition.

BME 7951. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisite: Doctoral student standing, and consent of the instructor and of the Graduate Advisor of Record. This course consists of independent, original research under the direction of a faculty advisor. May be repeated for a maximum of 18 credit hours. (Same as BIME 6097 at UT Health San Antonio.) This course has Differential Tuition.

BME 7952. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisite: Doctoral student standing, and consent of the instructor and of the Graduate Advisor of Record. This course consists of independent, original research under the direction of a faculty advisor. May be repeated for a maximum of 18 credit hours. (Same as BIME 6097 at UT Health San Antonio.) This course has Differential Tuition.

BME 7953. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisite: Doctoral student standing, and consent of the instructor and of the Graduate Advisor of Record. This course consists of independent, original research under the direction of a faculty advisor. May be repeated for a maximum of 18 credit hours. (Same as BIME 6097 at UT Health San Antonio.) This course has Differential Tuition.

BME 7956. Doctoral Research. (0-0) 6 Credit Hours.
Prerequisite: Doctoral student standing, and consent of the instructor and of the Graduate Advisor of Record. This course consists of independent, original research under the direction of a faculty advisor. May be repeated for a maximum of 18 credit hours. (Same as BIME 6097 at UT Health San Antonio.) This course has Differential Tuition.

BME 7991. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisite: Admission to Doctoral candidacy, and consent of the Graduate Advisor of Record and Dissertation Advisor. May be repeated for a maximum of 18 credit hours. (Same at BIME 7099 at UT Health San Antonio.) This course has Differential Tuition.

BME 7992. Doctoral Dissertation. (0-0) 2 Credit Hours.
Prerequisite: Admission to Doctoral candidacy, and consent of the Graduate Advisor of Record and Dissertation Advisor. May be repeated for a maximum of 18 credit hours. (Same at BIME 7099 at UT Health San Antonio.) This course has Differential Tuition.

BME 7993. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisite: Admission to Doctoral candidacy, and consent of the Graduate Advisor of Record and Dissertation Advisor. May be repeated for a maximum of 18 credit hours. (Same at BIME 7099 at UT Health San Antonio.) This course has Differential Tuition.

BME 7996. Doctoral Dissertation. (0-0) 6 Credit Hours.
Prerequisite: Admission to Doctoral candidacy, and consent of the Graduate Advisor of Record and Dissertation Advisor. May be repeated for a maximum of 18 credit hours. (Same at BIME 7099 at UT Health San Antonio.) This course has Differential Tuition.

Chemical Engineering (CME) Courses

CME 5503. Chemical Engineering Ethics and Leadership. (3-0) 3 Credit Hours.
A study of professional engineering ethics, including the history of ethical thinking, codes and professionalism, and problem-solving techniques. The connection of engineering ethics to emerging ESG issues. Leadership is introduced using the Student Leadership Challenge to provide fundamental principles of leadership. The course will include case studies, guest speakers, and experiential learning to reinforce the topics. This course has Differential Tuition.

CME 6103. Chemical Engineering Kinetics and Reactor Design. (3-0) 3 Credit Hours.
This course will cover the study of chemical reaction kinetics and mechanisms in complex homogeneous and heterogeneous reaction systems. It will include analysis of experimental data, modeling, and analysis and design of chemical reactors for such systems. This course has Differential Tuition.

CME 6113. Heterogeneous Catalysis and Surface Science. (3-0) 3 Credit Hours.
Students will learn about important industrial catalysts for a variety of applications in energy and fuels, the environment, and sustainability. They will learn about the functions of different key components within a formulation. Students will gain insight into the characterization of catalysts by temperature-programmed methods, adsorption approaches, spectroscopic techniques, and isotope tracers. They will learn about catalyst performance parameters, such as selectivity, activity, and stability. They will examine the root causes of deactivation (sintering, attrition, Ostwald ripening, oxidation, and poisoning), as well as possibilities for catalyst regeneration. They will learn about how diffusional limitations can impact catalyst performance. This course has Differential Tuition.

CME 6123. Electrochemical Engineering. (3-0) 3 Credit Hours.
This course will teach the fundamentals of electrochemistry and apply them to electrochemical reactor analysis and design. Building on a theoretical foundation of thermodynamics, kinetics and transport processes in electrochemical systems, and current and potential distribution, this course will examine corrosion engineering, electrodeposition, batteries and fuel cells, industrial electrolysis, and electrosynthesis. This course has Differential Tuition.

CME 6133. Biochemical Engineering. (3-0) 3 Credit Hours.
The course will introduce students to the principles that govern biochemical processes. Topics to be covered include fluid, heat, and mass balances involved with chemical and enzymatic reactions and microbial cell growth kinetics and transport. A focus will be given to fermenters, their design, and applications in the industry. This course has Differential Tuition.

CME 6203. Advanced Chemical Engineering Thermodynamics. (3-0) 3 Credit Hours.
Advanced treatment of pure and multicomponent thermodynamic systems. Topics covered include equations of state, corresponding states, activity coefficient models, and intermolecular forces. The focus of the course is on phase and chemical equilibria in chemical engineering. This course has Differential Tuition.

CME 6303. Transport Phenomena. (3-0) 3 Credit Hours.
Advanced study of single and multidimensional steady-state and transient problems in heat, mass, and momentum transfer. The course includes analytical and numerical approximation methods and boundary layer theory. This course has Differential Tuition.

CME 6403. Mathematical Methods in Chemical Engineering. (3-0) 3 Credit Hours.
This course will introduce students to advanced mathematical methods necessary to solve problems frequently encountered in chemical engineering and related disciplines. Topics covered include multivariable calculus, vector algebra, vector differential and integral calculus, and ordinary and partial differential equations. This course has Differential Tuition.

CME 6601. Chemical Engineering Research Seminar. (1-0) 1 Credit Hour.
Students will attend research presentations by invited speakers. The seminar coordinator may require students to present their research. May be repeated for credit, but no more than 4 credit hours may be applied to the Ph.D. in Chemical Engineering. The grade report for the course is either "CR" (satisfactory performance) or "NC" (unsatisfactory performance). This course has Differential Tuition.

CME 6703. Electronic and Local Atomic Structure using Synchrotron Methods. (3-0) 3 Credit Hours.
In this course, the student will learn how to model the local atomic structure of metal and metal oxide catalysts by extended X-ray absorption fine structure spectroscopy using software such as WinXAS, Atoms, FEFF, and FEFFIT. The student will learn how to reduce and normalize experimental data with WinXAS. Then, the student will utilize Atoms software to arrange atoms spatially, requiring knowledge of basic crystallography. The student will construct theoretical spectra for extended X-ray absorption fine structure spectroscopy based on interatomic interactions and scattering paths. The student will then utilize FEFFIT to fit experimental data with theoretical spectra using parameters such as coordination number, Debye-Waller factor, lattice contraction/expansion, and shift in binding energy. This course has Differential Tuition.

CME 6803. Introduction to Polymer Science and Engineering. (3-0) 3 Credit Hours.
This course reviews the basic principles and features of polymeric materials to identify and understand the key structure-property-processing relationship of polymers, understand and apply polymers design for different applications, including biomedical applications, evaluate the trend of polymeric materials, and design and analyze the performance of contemporary polymeric materials. This course has Differential Tuition.

CME 6813. Self-healing Polymers. (3-0) 3 Credit Hours.
This course covers basic principles and features of self-healing polymers including fundamental physical and chemical properties, mathematical models, synthesis, processing, characterization, and contemporary applications. This course has Differential Tuition.

CME 6903. Fundamentals of Interfaces, Nanoparticles, and other Colloids. (3-0) 3 Credit Hours.
Introduction to nanoparticle colloids, emulsions, foams, and interfacial science. Topics covered include thermodynamics of interfaces, wetting, interfacial tension, molecular scale forces at interfaces, DLVO theory, and non-DLVO forces. This course has Differential Tuition.

CME 6943. Chemical Engineering Internship. (0-0) 3 Credit Hours.
Internship in a non-academic R&D center. No more than 3 credit hours will apply to the Ph.D. in Chemical Engineering. This course has Differential Tuition.

CME 6951. Independent Study in Chemical Engineering. (0-0) 1 Credit Hour.
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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours may be applied to the degree. This course has Differential Tuition.

CME 6952. Independent Study in Chemical Engineering. (0-0) 2 Credit Hours.
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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours may be applied to the degree. This course has Differential Tuition.

CME 6953. Independent Study in Chemical Engineering. (0-0) 3 Credit Hours.
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 regular course offerings. May be repeated for credit on a different topic of study, but no more than 6 credit hours may be applied to the degree. This course has Differential Tuition.

CME 6973. Topics in Chemical 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 as topics vary, but not more than 6 hours may be applied to the Ph.D. in Chemical Engineering. This course has Differential Tuition.

CME 7101. Doctoral Research. (0-0) 1 Credit Hour.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. This course has Differential Tuition.

CME 7102. Doctoral Research. (0-0) 2 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. This course has Differential Tuition.

CME 7103. Doctoral Research. (0-0) 3 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. This course has Differential Tuition.

CME 7106. Doctoral Research. (0-0) 6 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. This course has Differential Tuition.

CME 7201. Doctoral Dissertation. (0-0) 1 Credit Hour.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Dissertation is required. This course has Differential Tuition.

CME 7202. Doctoral Dissertation. (0-0) 2 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Dissertation is required. This course has Differential Tuition.

CME 7203. Doctoral Dissertation. (0-0) 3 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Dissertation is required. This course has Differential Tuition.

CME 7206. Doctoral Dissertation. (0-0) 6 Credit Hours.
This course consists of independent, original research under the direction of a faculty advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Dissertation is required. This course has Differential Tuition.

Engineering (EGR) Courses

EGR 6113. Curriculum, Instruction, and Assessment. (3-0) 3 Credit Hours.
Prerequisite: CI 6003. Examination of different pedagogical approaches to the teaching and learning process in schools, with emphasis on the development of curriculum for classroom instruction, evaluation, organization, and management. This course has Differential Tuition.

EGR 6183. Engineering Education Methods. (3-0) 3 Credit Hours.
This course is designed to provide graduate students with an opportunity to acquire foundational knowledge on theories of teaching and learning in engineering education. The course contains principles of inclusive, learner-centered, and evidence-based pedagogy and assessment in engineering learning environments. This course serves as an opportunity to gain knowledge about the role of engineers as educators, mentors, and advisors through critical examinations of theory, disciplinary literacies, dominant ideologies, and empirical research in engineering education. This course has Differential Tuition.

EGR 6283. Mentored Teaching in Engineering. (3-0) 3 Credit Hours.
This course allows students the opportunity for a deeper understanding of teaching and learning through practice, feedback, and reflection as performed regularly in assigned teaching duties. Educational goals and objectives are identified, and engaging and meaningful activities are designed to address the learning goals using asset-based, student-centered curricular strategies. Students have the opportunity to develop assessments of the classroom activities and methods they use to support student learning. Reflection is used as a central method for learning and formatively evaluating the educator's practice. Topics include equity in education, inclusive teaching, grading and assessment, engagement activities, and cultural relevance. This course has Differential Tuition.

EGR 6293. Professional Development in Engineering Education. (3-0) 3 Credit Hours.
This course provides students with an opportunity to acquire an awareness of the Standards for Professional Development for Teachers of Engineering. Students will have an opportunity to practice strategies for designing and delivering professional development experiences for teachers and instructors of engineering. Students will be made aware of future careers and professional advancement opportunities at institutions of higher education, K-12 settings, corporate training, and formal and informal educational environments. This course has Differential Tuition.

EGR 6313. Teaching Engineering through Spatial Visualization. (3-0) 3 Credit Hours.
This course provides students the opportunity to explore research and pedagogical approaches to integrating spatial visualization as a skill to support students and professionals within the science, technology, engineering, and math (STEM) curricula. Instruction and exercises will be provided to allow students the opportunity to practice some spatial visualization skills. The course will also allow for the exploration of some technologies that can support various forms of visual representation of data. Examples include medical imaging, communication technology, transportation technology, and energy and power technology. This course has Differential Tuition.

EGR 6453. Engineering for Social Justice. (3-0) 3 Credit Hours.
This course examines the role of engineers in society, the complexity of sociotechnical challenges, the importance of diversity and inclusion in spaces where engineering is practiced, and the ways in which engineering can be used as a vehicle to rectify injustices created by engineered designs and artifacts. The course also provides an opportunity to acquire the tools to critically analyze engineering systems, challenge dominant engineering discourses, and reshape the practice of engineering. This course has Differential Tuition.

EGR 6463. Engineering Social Responsibility and Ethics. (3-0) 3 Credit Hours.
This course provides students with an opportunity to acquire foundational perspectives on engineering ethics and social responsibility in relationship to individuals, industry, and the public welfare in both education and practice. The course places emphasis on the unified nature of ethics, philosophy, morality, legal responsibility, and social issues. This course has Differential Tuition.

EGR 6513. Human Centered Design and the Impact of Modern Technologies. (3-0) 3 Credit Hours.
This course explores the issues faced by society as technology becomes an integral part of human life. The course provides students with opportunities to think critically, practically, creatively, and responsively about technological and social challenges; and encourages them to examine potential solutions to challenges of their own. The course also explores and discusses the socio-technological and user interplay in engineering design. This course has Differential Tuition.

EGR 6653. Foundations of Engineering Education Research Methodologies. (3-0) 3 Credit Hours.
This course provides students with an introduction to the field of engineering education research. The course offers students the opportunity to critically explore, analyze, and apply theoretical and conceptual frameworks to guide and conduct engineering education research. The course also allows students opportunities to examine the processes to engage in ethical research practices in engineering spaces. This course has Differential Tuition.

EGR 6853. Advanced Engineering Education Research Methodologies. (3-0) 3 Credit Hours.
Prerequisite: EGR 6653 or instructor approval. This course offers an in-depth examination of research study designs and methodologies in engineering education research. An exploration of current and emerging research methods in engineering education research are analyzed, critiqued, and evaluated throughout the course. The course also provides students with theoretical literature on quantitative, qualitative, and mixed-methods research approaches from different fields such as psychology, sociology, anthropology, and STEM education to explore their relation to engineering education. Course may be repeated for credit when topics vary. This course has Differential Tuition.

EGR 6913. Advanced Topics in Interdisciplinary STEM Education. (3-0) 3 Credit Hours.
Topics and critical issues in interdisciplinary STEM education. Topics include a focus on (1) research and development of innovative STEM learning and emerging STEM learning environments both in and out of school settings and (2) research that advances the field of formal and informal STEM Education. Course may be repeated for credit when topics vary. This course has Differential Tuition.

EGR 6932. Engineering Education Practicum. (2-0) 2 Credit Hours.
The purpose of this course is to expose students to challenge-based instructional pedagogies under the supervision of the faculty advisor. This course is a practical introduction to engineering education that considers technical and social justice challenges in the community. The course allows for the development of transforming leadership competencies, connects students to their surrounding community through an engineering lens, and provides an experiential and collaborative learning experience that integrates knowledge. This course has Differential Tuition.

EGR 6943. Graduate Project. (0-0) 3 Credit Hours.
Students will have the opportunity to demonstrate acquired skills in engineering education by carrying out a major culminating engineering education project using the engineering design process. This semester-long project must have the prior approval of a supervising faculty member. Credit will be awarded upon successful submission of a written report. May be repeated once for elective credit, but not more than 6 hours will apply to the master's degree. Enrollment is required each term in which the project is in progress. This course has Differential Tuition. Course fee: DL01 $75.

EGR 6973. Special Problems: Becoming an Engineering Educator. (3-0) 3 Credit Hours.
An organized course offering the opportunity for specialized study in engineering education for instructors in either a college/university setting or a K#12 educational classroom. This course covers the theoretical foundations of engineering curriculum design, a culturally responsive teaching framework for teaching engineering content, and using engineering design as the impetus for student learning of STEM content. Students will be provided the opportunity to enhance other valuable skills for engineering educators, such as writing grant proposals, managing active learning classrooms, and developing teaching methods to enable diverse student learning. This course may be repeated for credit when topics vary. This course has Differential Tuition.

EGR 6981. Master's Thesis Research. (0-0) 1 Credit Hour.
Prerequisite: Master's student standing and consent of the instructor and the Graduate Advisor of Record. Students pursuing the thesis option will receive guidance through this course and the opportunity to propose, execute, summarize, and defend a research project. This course has Differential Tuition.

EGR 6982. Master's Thesis Research. (0-0) 2 Credit Hours.
Prerequisite: Master's student standing and consent of the instructor and the Graduate Advisor of Record. Students pursuing the thesis option will receive guidance through this course and the opportunity to propose, execute, summarize, and defend a research project. This course has Differential Tuition.

EGR 6983. Master's Thesis Research. (0-0) 3 Credit Hours.
Prerequisite: Master's student standing and consent of the instructor and the Graduate Advisor of Record. Students pursuing the thesis option will receive guidance through this course and the opportunity to propose, execute, summarize, and defend a research project. This course has Differential Tuition.

EGR 6991. Research Seminar. (1-0) 1 Credit Hour.
Organized research lectures and seminar presentations related to innovative topics in Engineering Education will be offered. The grade report for this course is either “CR” (satisfactory participation in the seminar) or “NC” (unsatisfactory participation in the seminar). This course may include a written component. Course may be repeated for credit, but not more than 1 hour will apply to the master’s degree, regardless of the discipline in which the project is in progress. This course has Differential Tuition.