GRADUATE HANDBOOK
MS IN BIOENGINEERING

WELCOME!

Dear New and Returning Students:

Congratulations and welcome to Texas Tech University! We are excited that you are joining Tech's vibrant graduate and professional student community. We are here to ensure that you find a stimulating intellectual and social community of students and scholars from across the college and the university. We also want to help you understand the sometimes-confusing world of Texas Tech. The University provides many resources to support you through your studies, but they aren't useful if you don't know how to use them. The Bioengineering program has bundled information about all the resources available to you in this convenient resource guide, so hang on to it. This guide will give you valuable information you will need throughout your semester.

If you have concerns, or need more information, please contact me at jerry.t.trevino@ttu.edu or email me to make an appointment to see me in my office (MERC 25E).

Sincerely,

Jerry JT Trevino
Graduate Academic Advisor
jerry.t.trevino@ttu.edu

Liz Beaty
Director, Whitacre Online Learning
liz.beaty@ttu.edu

Changzhi Li, PhD
Associate Dean of Research and Graduate Programs, Professor
changzhi.li@ttu.edu

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PROGRAM OBJECTIVES

The Bioengineering program produces graduates who will fill positions in research and development in the field of biomedical engineering or who will pursue further higher studies. According to the National Institutes of Health,

"*Biomedical engineering [bioengineering] integrates physical, chemical, mathematical, and computational sciences and engineering principles to study biology, medicine, behavior, and health. It advances fundamental concepts, creates knowledge from the molecular to the organ systems levels, and develops innovative biologies, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis, and treatment of disease, for patient rehabilitation, and for improving health.*"

Fields of specialization for Texas Tech graduates can include bioinstrumentation, bioinformatics, bio-materials, biomechanics, biochemistry, biomedical imaging, and occupational bio-ergonomics. Graduates may seek employment on the research staffs of pharmaceuticals, medical device and consumer product companies, engineering schools, medical schools, hospitals, and government agencies.

GRADUATE STUDENT RESPONSIBILITIES

Graduate study demands advanced intellectual ability and the capacity for independent thought and investigation. The graduate student should, therefore, be characterized by maturity of intellect and character, and should be one whose approach to learning is distinguished by a spirit of inquiry and the desire to increase human knowledge. The graduate student should be an individual who can assume responsibility for their direction of study and research and for the ultimate success of their degree program.

Be familiar with all Graduate School, College, and University policies and procedures.

Be familiar with program policies and procedures, especially those that directly affect the student's degree plan and course of study.

Be aware of all deadlines and other matters related to completing all degree requirements.

Conform to professional standards of honesty in order to assure academic integrity and professionalism and acknowledge assistance, materials, etc., provided by others.

ACADEMIC REQUIREMENTS, POLICIES, AND PROCEDURES

Degree Options

MS in Bioengineering Thesis Option

The thesis option requires 24 hours of coursework, plus six hours of thesis. Up to 6 hours of coursework can be transferred into the program. At least half of the student's total coursework must be in courses taught within the Whitacre College of Engineering. Students must have an adequate mathematics background equivalent to an undergraduate differential equations-level course as well as at least one semester each of Chemistry and Calculus-based Physics. Students must complete a thesis, deliver an oral presentation of the results, and have their written thesis approved by the committee and graduate school. Students, upon acceptance, are considered to be non-thesis. After a suitable thesis advisor has been identified and has agreed to guide the thesis research, a student can change to the thesis option and receive advising from that faculty member. Your Degree Plan must be submitted following your first semester of enrollment (or the completion of 9 hours). For this degree option, students must complete a thesis, deliver an oral presentation of the results, and have their written thesis approved by their committee and graduate school.

Complete 30 total credit hours
Core: 12 credit hours [BioE (9) courses + Math (3)]
Electives: 12 credit hours [May be non-engineering courses]
Thesis: 6 credit hours

MS in Bioengineering Non-Thesis Option

The non-thesis option requires 30 hours of coursework. Up to 6 hours of coursework can be transferred into the program. At least half of the student's total coursework must be in courses taught within the Whitacre College of Engineering. Students must have an adequate mathematics background equivalent to an undergraduate differential equations-level course and undergraduate level statistics and probability. In the final semester, students must take the Master's report course which will also serve as their comprehensive exam report. Students, upon acceptance, are considered to be non-thesis. The graduate faculty advisor for non-thesis students is JT Trevino. Your Degree Plan must be submitted following your first semester of enrollment (or the completion of 9 hours).

Complete 30 total credit hours
Core: 12 credit hours [BioE (9) courses + Math (3)]
Electives: 15 credit hours [May be non-engineering courses]
Reports Course (ENGR6330): 3 credit hours

MS in Bioengineering Non-Thesis Online Option

The non-thesis online option requires 30 hours of coursework. Up to 6 hours of coursework can be transferred into the program and up to half of the coursework may be non-engineering courses. Students must have an adequate mathematics background equivalent to an undergraduate differential equations-level course and undergraduate level statistics and probability. In the final semester, students must take the Master's report course which will also serve as their comprehensive exam report. Students, upon acceptance, are considered to be non-thesis. The graduate faculty advisor for non-thesis online students is JT Trevino. Your Degree Plan must be submitted following your first semester of enrollment (or the completion of 9 hours).

Courses

Core Bioengineering Courses
Take at least **three** courses from the given list of core bioengineering courses.

ChE 5363: Biochemical Engineering (Online Option)
ChE 5364: Chemical Engineering Applications in Biological Systems
ChE 5366: Biomicrofluidics
ChE 5385: Bioprocess Control
ECE 5350: Introduction to Medical Instrumentation
ECE 5351: Biomedical Signal Processing (Online Option)
ECE 5356: Biosensors and Bioelectronics
ECE 5367: Image Processing
ENGR 5000: Special Topics in Engineering: Advanced Biomaterials (Online Option)
ENGR 5000: Special Topics in Engineering: Intro to Bioengineering 2
ENGR 5000: Special Topics in Engineering: Tissue Engineering 2
ENGR 5301: Intro to Bioengineering 1 (Online Option)
ENGR 5302: Tissue Engineering 1
IE 5356: Biomedical Design and Manufacturing (Online Option)
ME 5358: Biomaterials (Online Option)

Core Math Courses
Take at least **one** course from the given list of core math courses.

ChE 5310: Advanced Chemical Engineering Techniques (Online Option)
ChE 5372: Engineering Experimentation
ECE 5371: Engineering Analysis (Online Option Summer)
IE 5342: Design of Experiments (Online Option)
IE 5344: Statistical Data Analysis (Online Option)
MATH 5310: Principles of Classical Applied Analysis I
MATH 5330: Theory of Ordinary Differential Equations I
MATH 5332: Partial Differential Equations I
MATH 5334: Numerical Analysis I
MATH 5354: Biomathematics I

MATH 5355: Biomathematics II
ME 5301: Analysis of Engineering Systems (Online Option)
STAT 5373: Design of Experiments
STAT 5384: Statistics for Engineers and Scientists I
STAT 5385: Statistics for Engineers and Scientists II

Elective Engineering Courses

Electives are very diverse in nature. Students are encouraged to explore courses outside their specific backgrounds. Approval in advance by the advisor is required for each course selected under this category. Many courses have been pre-approved as free electives.

Any remaining bioengineering core courses from the list above.
CE 5383: Bioremediation of Wastes in Soil Systems
CE 5385: Microbial Applications in Environmental Engineering (Online Option)
CS 5341: Pattern Recognition (Online Option)
CS 5368: Intelligent Systems (Online Option)
CS 5388: Neural Networks (Online Option)
CS 5392: Reinforcement Learning (Online Option)
CS 5393: Bioinformatics (Online Option)
ECE 5332: Special Topics in ECE: Acquisition and Processing of the EEG (Online Option)
ECE 5363: Pattern Recognition
ECE 5364: Digital Signal Processing
ECE 5370: Machine Learning
ENVE 5315: Environment Chemistry for Pollution Management (Online Option)
IE 5301: Advanced Industrial Ergonomics (Online Option)
IE 5304: Biomechanics and Work Physiology (Online Option)
IE 5305: Advanced Cognitive Engineering (Online Option)
IE 5306: Advanced Systems Safety Engineering (Online Option)
ME 5340: Elasticity (Online Option)
ME 5356: Digital Human Modeling for Human – Centric Design
ME 6330 Advanced Topics in ME: Advanced Medical Imaging (Online Option)
Other courses with advisor's consent.

Elective Non-Engineering Courses

BIOL 5306: Advanced Cancer Biology
BTEC 5301: Introduction to Biotechnology
BTEC 5313: Experimental Mass Spectrometry in Biotechnology
BTEC 5322: Bioinformatics: Methodologies and Applications
BTEC 5333: Advanced Bioinformatics
BTEC 5338: Methods in Biotechnology
CHEM 5320: Analytical Spectroscopy
CHEM 5330: Biochemistry I
CHEM 5331: Biochemistry II
CHEM 5332: Biochemistry III

CHEM 5334: Principles of Biochemistry
CHEM 5335: Physical Biochemistry
GEOL 5304: Techniques in Electron Microscopy and Microanalysis
MBIO 5403: Immunobiology
Other courses with advisor's consent.

Advisor
The graduate faculty advisor for thesis, non-thesis, and non-thesis online students is Dr. Changzhi Li and the graduate academic advisor is Jerry "JT" Trevino. If you are interested in bioengineering-related research and planning to complete the thesis option, you can find a potential thesis advisor by getting in touch with bioengineering related faculty members (available in this website www.depts.ttu.edu/coe/bioengineering/faculty.php) whose area of research interest you. Once you identify a thesis advisor based on mutual interests and availability of projects, you will be advised by that faculty member and enroll in research and/or thesis credits in your faculty thesis advisor's department.

Enrollment Requirements
- Normal full-time enrollment varies between 9-16 credits; the minimum for full-time status is 9 credits. International students have to take a minimum of 9 credits every semester (except final semester when they can take a minimum of 3 credits).
- Students on fellowships, assistantships (TA, RA, GPTI), or other appointments designated for support of graduate students must enroll in at least 9 credits per long semester and 6 credits during summer.
- Students who have begun master's thesis or research must enroll in at least 1 credit of 6000 every semester until their term of graduation.
- Term of graduation: Master's student in a thesis option must enroll in at least 3 credits of 6000 during their last semester of graduation. Students in a non-thesis master's program must enroll in at least one credit of non-thesis coursework during their final semester.
- Responsible Academic Conduct (RAC) Training. All new and continuing degree-seeking graduate students are required to complete the RAC Training within their first semester of study. Students who do not complete the requirement will have a **registration hold placed on their student record**. Training can be accessed from the TTU Graduate School website (www.depts.ttu.edu/gradschool/training/responsible-academic-conduct-training.php). Questions about the training may be addressed to responsible.academic.conduct.gradschool@ttu.edu
- Students receiving financial assistance must register for the number of hours required by Financial Aid.

Questions about enrollment may be directed to Graduate School Enrollment Services (enrollment.services.gradschool@ttu.edu).

Continuous Enrollment Policy
Normal full-time enrollment varies between 9-16 credits; the minimum for full-time status is 9 credits for Spring and Fall Semester and 6 credits for Summer Semester. International students must take a minimum of 9 credits every long semester (except final semester when they can take a minimum of 3 credits). Students on fellowships, assistantships (TA, RA, GPTI), or other appointments designated for support of graduate student must enroll in at least 9 credits in Fall

and Spring and 6 credits in Summer. Students who have begun master's thesis or research must enroll in at least 1 credit of 6000 every semester until their term of graduation. Master's student in a thesis option must enroll in at least 3 credits of 6000 during their last semester of graduation. Students in a non-thesis master's program must enroll in at least one credit of non-thesis coursework during their final semester.

Transfer Credit
Up to 6 hours of coursework can be transferred into the program.

Standards for Adequate Academic Progress
A student whose cumulative GPA falls below 3.0 is placed on academic probation. The student must raise the cumulative GPA within two consecutive long terms to avoid academic suspension. If semester GPA drops below 3.0 during the two-semester period, students are subject to academic suspension. If cumulative graduate GPA remains less than 3.0 and their term GPA is greater than 3.0 in the next term, they are placed on continued probation. If the student's overall GPA remains below 3.0 in the following term, they are placed on academic suspension.

Procedures for Master's Degree

Required Steps for the MASTER'S DEGREE thesis option

Step	ACTION	INITIATED THROUGH	SUBMITTED TO	TIME
1	Plan courses for degree	Graduate Advisor	Graduate Advisor	Prior to registration
2	Set up thesis advisory committee (consisting of at least 2 faculty members including thesis advisor)	Graduate Advisor	Graduate Advisor	Prior to filing "Program for the Master's Degree and Admission to Candidacy" form
3	File "PROGRAM FOR THE MASTER'S DEGREE AND ADMISSION TO CANDIDACY" form	Graduate Advisor or Chair, Advisory Committee	Graduate School Enrollment Management	After first semester of master's coursework, no later than the posted deadline
4	File changes in degree program, as necessary	Graduate Advisor or Chair, Advisory Committee	Graduate School Enrollment Management	As needed
5	Enroll in semester of graduation (at least 3 hours of thesis, if defending thesis)	Graduate Advisor or Chair, Advisory Committee	Registrar	Semester of graduation
6	File "STATEMENT OF INTENTION TO GRADUATE" form, including official title of thesis, if applicable.	Student	Graduate School Enrollment Management	Semester of graduation (One must be filed for each intended graduation semester)
7	Schedule Thesis defense. Send email to the Thesis Coordinator indicating the time and date of the defense.	Student	Graduate School Thesis Coordinator	Semester of graduation (usually about 6 weeks before graduation)
9	After defense, obtain committee signatures on the ORAL DEFENSE and THESIS-DISSERTATION APPROVAL FORM and submit to Graduate School	Student (thesis option)	Graduate School Thesis Coordinator	Prior to deadline during semester of graduation
10	Pay Thesis-Dissertation fee, if applicable	Student (thesis option)	Student Business Services	Prior to deadline during semester of graduation
11	After incorporating committee changes, submit .pdf file of thesis to the Electronic Thesis or Dissertation (ETD) site for official review	Student (thesis option)	Graduate School Thesis Coordinator	Semester of graduation (usually 5 weeks before graduation date)
12	Final grade for thesis hours (A or B) Grade will be "CR" until final semester	Chair, Advisory Committee	Registrar Final grade roll	End of semester
13	Submit official .pdf of thesis to ETD web site	Student	Graduate School Thesis Coordinator	Prior to deadline

Required Steps for the MASTER'S DEGREE non-thesis option

Step	ACTION	INITIATED THROUGH	SUBMITTED TO	TIME
1	Plan courses for degree	Graduate Advisor	Graduate Advisor	Prior to registration
2	File "PROGRAM FOR THE MASTER'S DEGREE AND ADMISSION TO CANDIDACY" form	Graduate Advisor or Chair, Advisory Committee	Graduate School Enrollment Management	After first semester of master's coursework, no later than the posted deadline
3	File changes in degree program, as necessary	Graduate Advisor or Chair, Advisory Committee	Graduate School Enrollment Management	As needed
4	Enroll in semester of graduation. Enroll in ENGR 6330 Master Report Course (this course has the comprehensive exam built in)	Graduate Advisor or Chair, Advisory Committee	Registrar	Semester of graduation
5	File "STATEMENT OF INTENTION TO GRADUATE" form	Student	Graduate School Enrollment Management	Semester of graduation (One must be filed for each intended graduation semester)
6	Submit your ENGR 6330 Master Report as requested in the course syllabus.	Student	Graduate School Thesis Coordinator	Semester of graduation (usually about 6 weeks before graduation)
7	After the ENGR 6330 Master Report Submission, the advisor sends REPORT ON COMPREHENSIVE EXAM FORM to Enrollment Management.	Graduate Advisor	Graduate School Enrollment Management	By posted deadline

POLICIES ON ACADEMIC INTEGRITY, ETHICS, DISCRIMINATION, HARASSMENT

Academic Integrity Statement

Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010]

Academic Dishonesty Definitions

Students must understand the principles of academic integrity and abide by them in all class and/or course work at the University. Academic Misconduct violations are outlined Part II, section B.2 of the Code of Student Conduct. If there are questions of interpretation of academic integrity policies or about what might constitute an academic integrity violation, students are responsible for seeking guidance from the faculty member teaching the course in question.

Discrimination, Harassment, and Sexual Violence Statement

Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights & Resolution, (806)-742-SAFE (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are:

- TTU Student Counseling Center, 806-742-3674, www.depts.ttu.edu/scc/ (Provides confidential support on campus.)
- TTU 24-hour Crisis Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.)
- Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.)
- The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, www.depts.ttu.edu/rise/ (Provides a range of resources and support options focused on prevention education and student wellness.)
- Texas Tech Police Department, 806-742-3931, www.depts.ttu.edu/ttpd/ (To report criminal activity that occurs on or near Texas Tech campus.)

Safety and Wellness

The Texas Tech University (TTU) and Edward E. Whitacre Jr. College of Engineering are committed to the safety and wellness of our students by providing various services and resources. Make sure you register with Tech Alert to get emergency notification by phone call, text, or email. You are encouraged to review the Emergency Action Plans (EAPs) and watch the videos of Know What To Do In Emergency Events and Surviving an Active Shooter Event Training to be prepared for those emergency situations. For your wellbeing, various services are available at Student Counseling Center and Student Health Services. The Student Wellness Center provides convenient walk-in services M-F from 8 AM to 5 PM. Furthermore, the Texas Tech Crisis HelpLine (806-742-5555) provides 24/7/365 assistance for students experiencing a crisis or distress.

Emergency/Crisis Phone Number

TTU Police (UPD) Emergency	911
TTU Police (UPD) Non-Emergency	806.742.3931
TTU Emergency Maintenance	806.742.4OPS (4677)
TTU EHS (M-F, 8 am – 5 pm)	806.742.3876
SafeRide	806.742.RIDE (7433)
TTU Crisis HelpLine	806.742.5555
Student Wellness Center (From Urgent Care to a Full-Service Pharmacy on site)	806.742.2848
Title IX Reporting	806.742.7233
The Dean of Students	806.742.2984

Grievances –
Related OP:
www.depts.ttu.edu/opmanual/OP64.07.php
www.depts.ttu.edu/dos/studentcomplaints.php

APPENDICES
Milestones in the program:
www.depts.ttu.edu/gradschool/academic/forms/List_of_Required_Major_Steps-Masters_Degree.pdf

Thesis Guidelines:
www.depts.ttu.edu/gradschool/academic/thesis_diss/forms/2021-2022/Formatting_Manual_2021.pdf

www.depts.ttu.edu/gradschool/academic/formsresources.php

Major Examinations
For MS thesis, defend your thesis through an oral examination
www.depts.ttu.edu/gradschool/academic/thesis_diss/defend_format_submit/DefendFormatSubmit.php

Graduate Assistantships
If you are appointed as a TA or RA by any department, the policies of that department will apply.

USEFUL LINKS

Professional Bioengineering Related Associations

Association for Computing Machinery (ACM) SIGBio (www.acm.org/special-interest-groups/sigs/sigbio)
American Institute for Medical and Biological Engineering (AIMBE) (www.aimbe.org/)
American Society for Healthcare Engineering (ASHE) (www.ashe.org/)
Biomedical Engineering Society (www.bmes.org/
Institute of Electrical and Electronics Engineers (IEEE) Engineering in Medicine & Biology Society (EMBS) (www.embs.org/)
International Society for Biofabrication (www.biofabricationsociety.org/)
International Society for Computational Biology (www.iscb.org/)
Society for Biological Engineering (SBE) (www.aiche.org/sbe)
Society for Biomaterials (www.biomaterials.org/)

Bioengineering Related Journals

Acta Biomaterialia (www.sciencedirect.com/journal/acta-biomaterialia)
Advanced Healthcare Materials (onlinelibrary.wiley.com/journal/21922659)
Annual Review of Biomedical Engineering (www.annualreviews.org/journal/bioeng)
Artificial Intelligence in Medicine (www.sciencedirect.com/journal/artificial-intelligence-in-medicine)
Bioactive Materials (www.sciencedirect.com/journal/bioactive-materials)
Bioinformatics (academic.oup.com/bioinformatics)
Biomaterials (www.sciencedirect.com/journal/biomaterials)
Biosensors and Bioelectronics (www.sciencedirect.com/journal/biosensors-and-bioelectronics)
Briefings in Bioinformatics (academic.oup.com/bib)
Biofabrication (iopscience.iop.org/journal/1758-5090)
Institute of Electrical and Electronics Engineers (IEEE) Journal of Biomedical and Health Informatics (www.embs.org/jbhi/)
IEEE Transactions on Biomedical Engineering (www.embs.org/tbme/)
IEEE Transactions on Computational Biology and Bioinformatics (TCBB) (www.computer.org/csdl/journal/bb)
IEEE Transactions on Medical Imaging (www.embs.org/tmi/)
Nature Biomedical Engineering (www.nature.com/natbiomedeng/)
Nature Biotechnology (www.nature.com/nbt/)

Bioengineering-related Conferences

Association for Computing Machinery Bioinformatics, Computational Biology, and Health Informatics (ACM BCB)
Biomedical Engineering Society (BMES) Annual Conference
Institute of Electrical and Electronics Engineers (IEEE) Big Data
IEEE Engineers in Medicine and Biology Society (IEEE EMBS)
IEEE EMBS Conference on Neural Engineering (NER)
International Conference on Machine Learning (ICML)
International Society for Computational Biology (ISCB)PSB
SPIE Medical Imaging

Software Links

Bioconductor (www.bioconductor.org/)
TTU HPCC (www.depts.ttu.edu/hpcc/accounts/studentrequest.php)
Maple (www.depts.ttu.edu/itts/software/maple.php)
Matlab (www.depts.ttu.edu/itts/software/matlab/index.php)
Python (www.python.org/)
R (www.r-project.org/)
Reactome (reactome.org/)