School of Biomedical ENGINEERING

Masters of Engineering-Bioengineering
Curriculum Requirements & Course Information

Curriculum Requirements:

The following lists the specific requirements for the Masters of Engineering degree. (Students must be able to answer yes to the following statements to earn your ME at CSU.):

- Minimum of 30 equivalent semester credits including 7 credits of Core courses, 12 credits of Foundation courses, at least 8 credits in the Depth area, and 3 credits in a Breadth area. Seminar, thesis and independent study cred its will not apply.
- Minimum of 24 semester credits earned at CSU (21 while in the graduate program).
- Minimum of 24 credits at the Graduate level- courses numbered 500 or above.
- Minimum of 15 credits of biomedical engineering (BIOM) courses. Additional courses may need to be taken as a Supplemental Requirement to satisfy provisional admission requirements, course prerequisites, or supplemental coursework stipulations.
- Program of study must be approved by an advisor prior to completing 15 credits toward the degree.

The degree awarded upon completion will be a Masters of Engineering in Engineering. Transcripts will indicate the specialty in Biomedical Engineering.

Core Courses

The following courses represent the core course requirements for the proposed graduate program. All ME students are required to complete the core course requirements.

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
BIOM/MECH 570	Bioengineering	3	MECH 307, MECH 324	F	Introduction to the various fields within bioengineering, includes research lectures from expert guest lecturers and significant engineering content.
BMS 500	Mammalian Physiology I	4	Six credits of biological science	F	Membrane function and electrical activity of cells, neurophysiology, blood and immune, muscle physiology, and cellular endocrinology.

Foundation Courses

A requirement of 12 credits designed to develop a foundation in biomedical engineering which is any 500-level or above regular BIOM coureswork.

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
BIOM/MECH 532	Materials Issues in Mechanical Design	3	MECH 331	F	Failure mechanisms from materials viewpoint with emphasis on use in design. Fracture, creep, fatigue and corrosion.
BIOM/MECH 671	Orthopedic Tissue Biomechanics	3	CIVE 560	S	Linear elastic, finite deformation and viscoelastic theories applied to the mechanical behavior of orthopedic tissues (bone, tendon, cartilage).
BIOM/MECH 525	Cell and Tissue Engineering	3	BC 351 or BIO 310 or BMS 300 or BMS 500/NB 501	S, E	Cell and tissue engineering concepts and techniques with emphasis on cellular response, cell adhesion kinetics, and tissue engineering design.
BIOM/ECE 526	Biological Physics	3	Math 340 or MATH 345; PH 142 or PH 122	S	Mathematical and physical modeling of biological systems. Mass transport in cellular environments. Electrical/mechanical properties of biomolecules.
BIOM/ECE 533* or	Biomolecular Tools for Engineers & Lab	3	Written consent of the instructor.	F	Theoretical and practical aspects for biomolecular laboratory techniques-PCR, cloning, FISH, and community profiling-in and engineering context
CIVE 534*	Applied and Environmental Molecular Biology	3	CIVE 540	S	Environmental microbiology and molecular biology tools used to investigate both natural systems and engineered processes.
BIOM/CBE 543	Membranes for Biotechnology and Biomedicine	3	CHEM341, CHEM343, CHEM 472 or equivalent, CBE 332 or equivalent	F	Polymeric membrane formation, modification, module design and applications to bioseparation and biomedical separations and tissue engineering.
BIOM/MECH 573	Structure and Function of Biomaterials	3	MECH 331	S	Structure-function relationships of natural biomaterials; application to analysis of biomimetic materials and biomaterials used in medical devices.
BIOM/MECH 531	Materials Engineering	3	MECH 331 or MECH 431	S	Structural engineering materials and their selection on basis of property, processing, and economic considerations, application of engineering materials for biomedical and biotechnology applications.

**Students may either take BIOM/ECE 533 or CIVE 534. (Credit will not count for both courses.) Students with a strong background in Cellular and Molecular Biology may substitute CM502 (Techniques in Cell and Molecular Biology).*

Depth Courses

Each student will select a depth area and take courses totaling at least 8 credits. The courses that are typically selected are listed for each interest area, however courses may be selected from more than one interest area.

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
BMS 501	Mammalian Physiology II	4	Six credits of biological science	S	Cardiovascular, respiratory, renal, digestive, endocrine, metabolic, reproductive function.
BMS 575	Human Anatomy Dissection	4	BMS 301 and written consent of instructor	F	Human cadaver dissection.
BMS 631	Mechanisms of Hormone Action	2	BMS 430 or BMS 501	S, O	Synthesis, secretion, and mechanisms of action of hormones.
BIOM/ECE 680A1	Methods in Nanoscale Biophysics	3	BIOM 526	S, E	
MECH 530	Advanced Composite Materials	3	CE 360, MECH 331	F	Materials aspects of advanced composite constituents and how their combination yields synergistic results.
MECH 531	Materials Engineering	3	MECH 331 or MECH 431	S	Structural engineering materials and their selection on basis of property, processing, and economic considerations.
MECH 680A1	Advanced Computational Methods for Materials	3	CHEM 461 or MECH 331; CHEM 472 or CHEM 474 or MECH 337 or PH 361; MATH 340	S	Commonly used advanced computational methods in research in materials; first-principle calculations, molecular simulation, mesoscopic simulations.
HES 531	Muscle and Joint System Mechanics	3	BMS 301; HES 307	F, E	Integrate muscle, tendon, and location of bone attachment into a comprehensive understanding of human movement at the single- and multi-joint level.
ANEQ 565	Interpreting Animal Research	3	ANEQ 101; STAT 301 or STAT 307/ERHS 307	S	Designing, conducting, analyzing, and reporting of animal science research.
MIP 651	Immunobiology	3	MIP 342	F, E	Structure, function, regulation of immunoglobulins and the immune system. Cellular immunity including transplantation and cancer.
NB 505	Functional Neurobiology	3	BMS 325 or NB 501 or BMS 500	S	Anatomical and physiological organization of the nervous system.
BC 565	Molecular Regulation of Cell Function	4	LIFE 210; BC 403 or concurrent registration or BC 351	S	Molecular regulations of cell organization, membrane formation, organelle biogenesis, cell communication, shape and motility, growth, aging, and death.
CBE 503	Transport Phenomena Fundamentals	3	CBE 406	S	General topics in transport phenomena; analytical and numerical solutions of laminar flows; perturbation techniques; coupled transport.
ECE 512	Digital Signal Processing	3	ECE 312 or written consent of instructor	F, online	Linear and nonlinear optimization theory and methods; applications in systems, control, and communication.
ERHS 712	Physics of Diagnostic Imaging	3	DVM or equivalent professional veterinary medicine degree	F	Physics of imaging for radiology, ultrasounds, computerized tomography, magnetic resonance, and nuclear medicine.

Breadth Courses

Each student will select at least 3 credits in advanced or applied mathematics normally selected from, but not limited to:

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
MATH 545	Partial Differential Equations I	3	MATH 340 or MATH 345 or MATH 530.	F	Second order linear PDEs, elliptic and parabolic equations, equations of math physics, separation of variables, Fourier series.
STAT 511	Experimental Design and Data Analysis for Researchers I	4	STAT 301 or STAT/EH 307 or STAT 309 or STAT 311 or written consent of instructor.	F	Statistical methods for experimenters and researchers emphasizing design and analysis of experiments.
STAT 512	Experimental Design and Data Analysis for Researchers II	4	STAT 511 or written consent of instructor.	S	Statistical methods for experimenters and researchers emphasizing design and analysis of experiments.
STAT 520	Introduction to Probability Theory	4	MATH 229; MATH 261; MATH 317	F	Probability, random variables, distributions, expectations, generating functions, limit theorems, convergence, random processes.
STAT 521	Stochastic Processes I	3	STAT 520	S	Characterization of stochastic processes, Markov chains in discrete and continuous time, branching processes, renewal theory, Brownian motion.

F=Fall **S**=Spring **SS**=Summer **E**=Even Years **O**=Odd Years