COLLEGE OF ENGINEERING

Engineering Global Solutions

School of Biomedical Engineering

Masters of Engineering-Biomedical Engineering
Curriculum Requirements & Course Information

Curriculum Requirements:
The following lists the specific requirements for the Masters of Engineering degree:

- 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 credits 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.

Students will be actively involved and engaged with the development of cutting-edge technologies in this research-based curriculum. 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)	Interest Areas	Semesters Taught	Catalog Description
BIOM/MECH 570	Bioengineering	3	MECH 307, MECH 324	A	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	A	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.

Course Number	Title	Credits	Prerequisite(s)	Interest Areas	Semesters Taught	Catalog Description
BIOM/MECH 532	Materials Issues in Mechanical Design	3	MECH 331	B	F	Failure mechanisms from materials viewpoint with emphasis on use in design. Fracture, creep, fatigue and corrosion.
BIOM/MECH 571	Biomechanics	3	BIOM 470 or MECH/BIOM 570	B	S	Mathematical approach to analysis of living systems, their functions, diseases, and replaceable parts.
BIOM/CBE 525	Cell and Tissue Engineering	3	BC 351 or BIO 310 or BMS 300 or BMS 500/NB 501	B, MC	S	Cell and tissue engineering concepts and techniques with emphasis on cellular response, cell adhesion kinetics, and tissue engineering design.
BIOM/CIVE 535	Biomolecular Tools for Engineers & Lab	3	MIP 300 or BMS 300 (Credit not allowed for both BIOM 535 and CIVE 535.)	B, MC	F	Theoretical and practical aspects for biomolecular laboratory techniques-PCR, cloning, FISH, and community profiling-in and engineering context
BIOM/MECH 573	Structure and Function of Biomaterials	3	MECH 331	B, MC	S	Structure-function relationships of natural biomaterials; application to analysis of biomimetic materials and biomaterials used in medical devices.
BIOM/CBE 504	Fundamentals of Biochemical Engineering	3	MIP 300 and MATH225 or MATH 340 and BIOM/BH 306 or CBE 420 or concurrent registration	MC	F (alternating even years)	Application of chemical engineering principles to enzyme kinetics, fermentation and cell culture, product purification, and bioprocess design.
BIOM/CBE 522	Bioseparations Processes	3	CBE 331	MD	S	Analysis of processes used to recover and purify fermentation products.

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)	Interest Areas	Semesters Taught	Catalog Description
BMS 501	Mammalian Physiology II	4	Six credits of biological science	A	S	Cardiovascular, respiratory, renal, digestive, endocrine, metabolic, reproductive function.
BMS 560	Theory and	3	One semester of	A	S, E	Principles of molecular technology and applications to animal

	Practice of Animal Biotechnology		biochemistry or written consent of instructor			and human populations, including transgenic technology and gene therapy
BMS 575	Human Anatomy Dissection	4	BMS 301 and written consent of instructor	A	F	Human cadaver dissection.
BMS 631	Mechanisms of Hormone Action	2	BMS 430 or BMS 501	A	S, O	Synthesis, secretion, and mechanisms of action of hormones.
MECH 530	Advanced Composite Materials	3	CE 360, MECH 331	B	F	Materials aspects of advanced composite constituents and how their combination yields synergistic results.
MECH 532	Material Issues in Mechanical Design	3	MECH 331	B	F	Failure mechanisms from materials viewpoint with emphasis on use in design. Fracture, creep, fatigue and corrosion.
MECH 628	Applied Fracture Mechanics	3	CE 560	B	S, E	Stress distribution near cracks; energy criteria for fracture; design criteria; fracture toughness testing.
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	B	S	Commonly used advanced computational methods in research in materials; first-principle calculations, molecular simulation, mesoscopic simulations.
ANEQ 565	Interpreting Animal Research	3	ANEQ 101; STAT 301 or STAT 307/ERHS 307	B, MC	S	Designing, conducting, analyzing, and reporting of animal science research.
BMS 620	Cardiovascular Physiology	3	BMS 500	B, MC	S, O	Physiology and biophysics of the circulatory system.
MIP 651	Immunobiology	3	MIP 342	B, MC	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	B, MC	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	MC	S	Molecular regulations of cell organization, membrane formation, organelle biogenesis, cell communication, shape and motility, growth, aging, and death.
BC 663	Gene Expression	3	BC 563	MC	S	Eukaryotic transcription mechanisms with emphasis on methods of study and regulatory mechanisms.
CBE 503	Transport Phenomena Fundamentals	3	CBE 406	MC	S	General topics in transport phenomena; analytical and numerical solutions of laminar flows; perturbation techniques; coupled transport.

CM 501	Advanced Cell Biology	4	BIO 310 or written consent of instructor	MC	F	Cell structure and organelle function.
CM 520	Proteolytic Regulation of Cellular Processes	3	CM 501	MC	S, E	Functions of proteolytic pathways in the regulation of eukaryotic cellular processes, such as mitosis, apoptosis, signal transduction and gene regulation.
ECE 512	Digital Signal Processing	3	ECE 312 or written consent of instructor	MD	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	MD	F	Physics of imaging for radiology, ultrasounds, computerized tomography, magnetic resonance, and nuclear medicine.
MIP/BSPM 576	Bioinformatics	3	BC 463 or BIO 310 or CM 501 or MIP 450	MD	F, S	Technical computing across platforms using bioinformatics tools in molecular analyses.

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)	Interest Areas	Semesters Taught	Catalog Description
MATH 531	Discrete Models of Physical Systems	3	MATH 340 or MATH 345	A	F	Discrete models for physical systems; systems of ordinary differential equations, applied linear algebra; introduction to finite elements.
MATH 532	Continuous Models of Physical Systems	3	MATH 340 or MATH 345	A	S, SS	Mathematical theory and algorithms for modeling large data sets. Application to real world problems. Emphasis on geometric ideas.
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.	A	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.	A	S	Statistical methods for experimenters and researchers emphasizing design and analysis of experiments.

F=Fall **S**=Spring **SS**=Summer **E**=Even Years **O**=Odd Years * denotes course offered in the term specified on the <u>even year</u>

B=Biomechanics and Biomaterials **MC**=Molecular, Cellular, and Tissue Engineering ** denotes course offered in the term specified on the odd year
MD=Medical Diagnostics, Devices, and Imaging **A**=All