

# School of Biomedical ENGINEERING

## Biomedical Engineering Interdisciplinary Studies Minor Curriculum Requirements & Course Information *Non-Engineering Students*

### Curriculum Requirements:

- The undergraduate program requires completion of 21 credits with at least 12 credits greater than or equal to 300-level courses.
- Complete 8 credits of core courses.
- Complete 9 credits of engineering electives.
- Complete 4 credits of science, engineering, animal research, bioethics, and entrepreneurship electives.

### Core Courses: 8 Credits

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
BIOM 470	Biomedical Engineering	3	MATH 155 or MATH 160; PH 141	F	Engineering application in human/animal physiology, diagnosis of disease, treatment, rehabilitation, human genome manipulation.
BMS 300	Principles of Human Physiology	4	BZ 101 or BZ 110 or LIFE 102; CHEM 103 or CHEM 107 or CHEM 111	F, S, SS	Physiology of humans.
OT 215	Medical Terminology	1		F, S, SS	Definition and use of medical terms.

### Engineering Elective Courses: 9 Credits

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
CBE 201	Material and Energy Balances	3	CHEM 111; MATH 160; PH 141; 1 course in computer programming	F	Principles of chemistry, physics, and mathematics applied to development of material and energy balances; illustration of concepts.
CBE 210	Thermodynamic Process Analysis	3	CBE 201	S	Thermodynamic fundamentals and applications to ideal and non-ideal mixtures, power cycles, and chemical equilibria.
CBE 320	Chemical and	3	CBE 201; LIFE 102;	S	Mechanisms and rates of chemical reactions; design of homogeneous

	Biological Reactor Design		MATH 340		and heterogeneous reactors; biological reactions and reactors.
CBE 331	Momentum Transfer and Mechanical Separations	3	CBE 201; CBE 202 or MECH 237; MATH 340	F	Fluid properties; conservation equations; compressible and incompressible flow; pumping and metering; mixing; separation of fluid-solid mixtures.
CBE 406	Introduction to Transport Phenomena	3	CBE 332; CHEM 474	F	Fundamental treatment of momentum and mass transport processes; dimensional analysis for parameter identification and order of magnitude estimation.
CBE 430	Process Control and Instrumentation	3	CBE 320; CBE 330; CBE 442/ENVE 442	S	Measurement and control of process variable; transient behavior of chemical processes; feedback, feedforward, and computer control concepts.
CIVE 260	Engineering Mechanics-Statics	3	MATH 160; PH 141 or concurrent reg.	F, S	Forces using vector notation; static equilibrium of rigid bodies; friction, virtual work, centroids, and moments of inertia.
CIVE 261	Engineering Mechanics-Dynamics	3	CIVE 260	F, S	Kinematics and kinetics of particles and rigid bodies; concepts of work-energy and impulse-momentum; computer applications; vector notation.
ECE 201	Circuit Theory	3	ECE 192 with a C- or better; concurrent reg. in MATH 161 and PH 142	F	Basic circuit analysis techniques and applications to engineering design problems.
ECE 204	Introduction to Electrical Engineering	3	MATH 161; PH 142	S	Basic analog and digital circuits and systems; introduction to electromechanical devices.
ECE 303/ STAT 303	Introduction to Communication Principles	3	ECE 311 or concurrent reg.; MATH 261	F	Basic concepts in design and analysis of communication systems.
ECE 331	Electronic Principles I	4	ECE 202 with a C- or better; MATH 340 or MATH 345	F	Discrete component semiconductor devices, characteristics and applications. Rectifier circuits, single-stage and multi-stage amplifiers.
ECE 341	Electromagnetic Fields and Devices I	3	MATH 340 with a C- or better or MATH 345 with a C- or better; PH 142 with a C- or better	F	Basic concepts of electrostatic and magnetostatic fields.
ECE/BIOM 480	Introduction to Biophysics	3	MATH 161 or MATH 255; PH 122 or PH 142	F	Quantitative analysis of biological systems. Physical properties of biomolecular, sub-cellular transport. Techniques of single molecule biophysics.
MECH 237	Introduction to Thermal Sciences	3	MATH 160; PH 142	F, S	First and second laws of thermodynamics, properties of materials, energy conversion, statistical aspects, heat transfer.
MECH 307	Mechatronics and	4	CIVE 261 with a C- or	F, S	Instrumentation and measurement system analysis and design; sensors

	Measurement Systems		better; ECE 204 with a C- or better; MATH 340 with a C- or better		and actuators; computer data acquisition and control.
MECH 331	Introduction to Engineering Materials	4	CHEM 111 with a C- or better; CHEM 112 with a C- or better; PH 142 with a C- or better	F, S	Characteristics of metallic, plastic, and ceramic material; basic principles which relate properties of materials to their atomic and microstructure.
MECH 342	Mechanics and Thermodynamics of Flow Processes	3	MATH 340 with a C- or better; MECH 337 with a C- or better or concurrent reg.; PH 141 with a C- or better	F, S	Engineering details of viscous flow with losses, measurements, compressibility, turbomachinery, convective heat transfer.
PH 245	Introduction to Electronics	3	MATH 161; PH 142	F	Selected topics in physics with emphasis on depth of understanding.

### Science, Engineering, Animal Research, Bioethics, and Entrepreneurship Courses: 4 Credits

Course Number	Title	Credits	Prerequisite(s)	Semesters Taught	Catalog Description
BC 351	Principles of Biochemistry	4	BZ 110 or BZ 120 or LIFE 102; CHEM 245 or CHEM 346 or concurrent reg. in CHEM 346	F, S, SS	Structure and function of biological molecules; biocatalysis; metabolism, and energy transduction; gene expression.
BZ 310	Cell Biology	4	BZ 110 or BZ 120 or LIFE 103; CHEM 245 with a C or better or CHEM 345 with a C or better	F, S	Structure and function of cells emphasizing molecular mechanism. Communication, metabolism, motility, genetics, growth, reproduction (Special course fee).
BIOM 486A-B	Biomedical Clinical Practicum	2-4	BMS 300; BIOM 470	F, S, SS	Biomedical lab work or exposure to the hospital/clinical environment.
BMS 301	Human Gross Anatomy	5	BZ 110 or LIFE 102	F	Structure and function of the human body. Study of prosected human cadavers; clinical applications; living anatomy (Special course fee).
BMS 325	Cellular Neurobiology	3	BMS 300 or BMS 360	F	Cellular and molecular bases of nervous system function and behavior.
BMS 345	Functional Neuroanatomy	4	BMS 300 or BMS 360	S	Functional systems and circuits of the human brain and spinal cord (Special course fee).
BMS 365	Nerve and Muscle-Toxins, Trauma, and Disease	3	BIO 310 or BMS 300 or BMS 360	S	Understanding cellular and molecular basis of nerve and muscle activities in health and disease.
BMS 420	Cardiopulmonary	3	BMS 300 or BMS 360	F	Normal and pathophysiology of cardiovascular and pulmonary systems.

	Physiology (BMS 300 or BMS 360)				
BMS 430	Endocrinology	3	BMS 300 or BMS 360	F	Physiology of the glands of internal secretion.
BUS 205	Legal and Ethical Issues in Business <sup>1</sup>	3		F, S, SS	Ethical, legal and regulatory issues in the US business environment.
CHEM 245	Fundamentals of Organic Chemistry	4	CHEM 107 or CHEM 113	F, S, SS	Nomenclature, structure, bonding, reactions, mechanisms, synthesis, stereochemistry of organic compounds.
CHEM 246	Fundamentals of Organic Chemistry Laboratory	1	CHEM 108 or CHEM 112 or CHEM 114; CHEM 245 or concurrent reg.	F, S	Laboratory applications of principles presented in CHEM 245 (Special course fee).
CHEM 345	Organic Chemistry I	4	CHEM 113; CHEM 114	F, S	Structure, nomenclature, dynamics, spectroscopy, reactions of organic molecules. Laboratory applications of principles presenting lecture (Special course fee).
HES 207	Anatomical Kinesiology	3		F, S, SS	Anatomical, physiological, and mechanical fundamental of human movement.
HES 307	Biomechanical Principles of Human Movement	3	BMS 301 or HES 207; PH 121 or PH 141	F, S, SS	Identify with and utilize biomechanical principles pertinent to human movement.
HES 403	Physiology of Exercise	4	BMS 300; LIFE 102	F, S, SS	Effects of exercise on tissues, organs, and systems of the body (Special course fee).
HES 405	Exercise Testing Instrumentation	2	HES 403	F, S	Theory and operation of devices commonly employed in quantifying factors related to exercise (Special course fee).
HES 420	Electrocardiography and Exercise Management	3	BMS 300	F, S	Interpretation of 12-lead ECG tracings, administering exercise tests, and prescribing exercise program for healthy individuals and special populations (Special course fee).
HES 476	Rehabilitation Exercise	3	HES 403	F, S	Interaction of physical activity with pathophysiology and treatment of chronic diseases and conditions.
HONR 499*	Senior Honors Thesis	3	HONR 399		* Must be biomedical focused. Must be approved by SBME Advisor or Director. Call 491-7157.
LIFE 103	Biology of Organisms- Animals and Plants	4	LIFE 102	F, S, SS	Diversity of animals and plants; their structural and functional characteristics (Special course fee).
MGT 420	New Venture Creation <sup>1</sup>	3	MGT 340	F	Entrepreneurs and the entrepreneurial process. Growth of an independent business.
MGT 440	New Venture Management <sup>1</sup>	3	MGT 420	S	Theories and skills necessary for managing startup and existing small firms.

MIP	300	General Microbiology	3	BZ 110 or BZ 120 or LIFE 102; CHEM 245 or concurrent reg. or CHEM 341 or concurrent reg. or CHEM 345 or concurrent reg.	F, S, SS	Structure, function, development, physiology, and molecular biology of microorganism emphasizing bacteria.
PHIL	205	Introduction to Ethics <sup>1</sup>	3	Sophomore standing or higher	F, S	Problems and theories concerning values and standards, right action, and the good life.
PHIL	305E	Philosophical Issues in the Professions-Animal Science <sup>1</sup>	3		F	Philosophical problems, theories relevant to specific professions-Animal science.
PSY	456	Sensation and Perception	3	PSY 250	F, S, SS	Review of research on physiological substrates of sensation; methods of scaling sensory experience; role of perception in behavioral adaption.
PSY	457	Sensation and Perception Laboratory	2	PSY 250; PSY 456 or concurrent reg.	F, S, SS	Review of research on physiological substrates of sensation; methods of scaling sensory experience. Role of perception in behavioral adaption.
STAT	315	Statistics for Engineers and Scientists	3	MATH 161 or MATH 255	F, S, SS	Calculus-based probability and statistics: distribution theory, estimation, hypothesis testing, applications to engineering and the sciences.

<sup>1</sup> Only three credits of non-technical courses may count toward minimum requirements.

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