Biomedical Engineering Graduate Concentration – Fall 2015

Biotechnology
Advisor: David Sept, Ph.D. (Fall 2015 term)
Advisor: Mohamed El-Sayed, Ph.D. (Winter 2016 term)

**BIOTECHNOLOGY:**
- BIOMEDE 410 Design and Applications of Biomaterials (3) (I)
- BIOMEDE 504 Cellular Biotechnology (3) (II)
- BIOMEDE 584 Advances in Tissue Engineering (3) (II)
- BIOPHYS 440 Biophysics of Diseases (3) (I)
- CHE 517 Biochemical Engineering (3) (I)

**GENERAL (both courses are required):**
- BIOMEDE 500 Biomedical Engineering Seminar (1) (I,II)
- BIOMEDE 550 Ethics and Enterprise (1) (I)

**BIOMEDICAL RESEARCH AND DESIGN (select one – BIOMEDE 590 or BIOMEDE 599.002 and BIOMEDE 599.004):**
- BIOMEDE 590 Directed Research (2-3) (I,II,III)
- BIOMEDE 599.002 Graduate BME Innovative Design Team (3) (I)
- BIOMEDE 599.004 Graduate BME Innovative Design Team (4) (II)

*NOTE: In order for BIOMEDE 599.002 and BIOMEDE 599.004 to count toward their degree in BME, students must register for these courses in both the fall and winter terms, and they must adhere to the following rules:*

  a) this course can be counted as a SUGS, terminal MS, or MS/PhD student's 2 credit hour technical elective (fall term) and Biomedical Research and Design requirement (winter term),
  b) this course, taken in both terms, can be counted as a technical elective for a student that has already taken BIOMEDE 590,
  c) this course can be counted as PhD coursework providing that it has not already been counted as the student's Biomedical Research and Design requirement or technical elective in their MS program, and the student's advisor approves.

**MATHEMATICS (select one course):**
- MATH 450 Advanced Mathematics for Engineers I (4) (I,II,IIIb)
- MATH 454 Boundary Value Problems for Partial Differential Equations (3) (I,II,IIIa)
- MATH 462 Mathematical Models (3) (II)
- MATH 463 Mathematical Modeling in Biology (3) (I)
- MATH 471 Introduction to Numerical Methods (3) (I,II,IIIb)
- MATH 550 Introduction to Adaptive Systems (3) (I)
- MATH 555 Introduction to Functions of a Complex Variable with Applications (3) (I,II)
- MATH 556 Applied Functional Analysis (3) (I)
- MATH 557 Applied Asymptotic Analysis (3) (II)
- MATH 558 Applied Nonlinear Dynamics (3) (I)
- MATH 559 Topics in Applied Mathematics (3)
- MATH 561 Linear Programming I (3) (I,II)
- MATH 562 Continuous Optimization Methods (3) (II)
- MATH 563 Advanced Mathematical Methods for the Biological Sciences (3) (II)
- MATH 564 Topics Math Biology (3)
- MATH 571 Numerical Linear Algebra (3) (I,II)
- MATH 572 Numerical Methods for Differential Equations (3) (II)
- MATH 651 Topics in Applied Mathematics I (3) (I,II)
- MATH 656 Introduction to Partial and Differential Equations (3) (I)
- MATH 657 Nonlinear Partial Differential Equations (3) (II)
- MATH 756 Advanced Topics in Partial Differential Equations (3)
MECHENG 501 Math Methods in Mechanics (3) (II)
MECHENG 564 Linear Systems Theory (4) (I)

BIOTECH (select one course):
BIOLCHEM 516 Intro Biochemistry Lab (3) (I)
BIOMEDE 458 Biomedical Instrumentation and Design (4) (I, II)
BIOMEDE 510 Medical Imaging Laboratory (3) (II)
IOE 432 Industrial Engineering Instrumentation Methods (3) (I)
MCDB 429 Cellular & Molecular Biology Lab (3) (II)

STATISTICS (select one course):
BIOMEDE 503 Statistical Methods for Biomedical Engineering (3) (II)
BIOSTAT 602 Biostatistical Inference (4) (I)
BIOSTAT 650 Applied Statistics I: Linear Regression (4) (I)
BIOSTAT 651 Applied Statistics II: Extensions for Linear Regression (3) (II)
EECS 501 Probability and Random Processes (4) (I, II)
IOE 461 Quality Engineering Principles and Analysis (3) (I)
STATS 470 Introduction to the Design of Experiments (4) (I)
STATS 500 Applied Statistics I (3) (I)
STATS 525 Probability Theory (3) (I)

NOTE: BME graduate students can only take EECS 501 in the winter term.

LIFE SCIENCE (two courses are required – at least one course must be outside of the College of Engineering):

Required:
BIOMEDE 519 Quantitative Physiology (4) (I)

Select one course:
ANAT 403 Human Anatomy (5) (I, II)
ANAT 541 Mammal Reprod (4) (II)
BIOLCHEM 451 Introductory Biochemistry I (4) (I)
BIOLCHEM 515 Introductory Biochemistry (3) (I, II)
BIOLCHEM 550 Macromol Struc & Func (3) (I)
BIOPHYS 520 Biophys Chem I (3) (I)
CANCIB 553 Cancer Biol (2) (I)
CDB 530 Cell Biology (3) (I)
CDB 550 Histology (4) (II)
CDB 581 Developmental Genetics (3) (I)
CDB 583 Stem Cells Regen Bio (3) (II)
KINESLGY 522 Clin Neurophys Image (3) (II)
KINESLGY 545 Metab Respon to Exer (3) (II)
MCDB 422 Cellular and Molecular Neurobiology (3) (I)
MCDB 423 Neurology Lab (3) (I)
MCDB 427 Molecular Biology (4) (I)
MCDB 428 Cell Biology (4) (II)
MCDB 429 Laboratory in Cell and Molecular Biology (3) (II)
MCDB 435 Intracellular Trafficking (3) (I)
MCDB 530 Cell Biology (3) (I)
MICROBIOL 440 Immunology (3) (II)
NEUROSCI 570 Human Neuroanatomy (3) (I)
NEUROSCI 601 Principles Neuro I (4) (I)
NEUROSCI 602 Principles Neuro II (4) (II)
PATH 581 Tissue, Cellular and Molecular Basis of Disease (4) (II)
PHYSIOL 592 Integrative Neuroscience (3) (I)
PHYSIOL 600 Pathophysiology (3) (II)
TECHNICAL ELECTIVES:
At least one graduate level engineering and biology course. For technical electives outside of those listed, you must obtain approval from the biotechnology advisor.

Sample Course Sequence:
Fall        BIOLCHEM 515 or BIOMEDE 519, BIOMEDE 500, BIOMEDE 550, STATS 500, Technical Elective
Winter     BIOMEDE 418, MCDB 429, Biotechnology
Fall       CHE 508, BIOMEDE 590, Technical Elective

Technical Electives with biotechnology content:
BIOINF 527 Introduction to Bioinformatics and Computational Biology (4) (I)
BIOLCHEM 504 Cell Biotech (3) (II)
BIOLCHEM 550 Protein Structures & Function (3) (I)
BIOMEDE 410 Design and Applications of Biomaterials (3) (I)
BIOMEDE 456 Tissue Mechanics (3) (I)
BIOMEDE 476 Biofluid Mechanics (4) (II)
BIOMEDE 479 Biotransport (4) (II)
BIOMEDE 556 Cellular and Molecular Biomechanics (3) (I)
BIOMEDE 599 Special Topics (1-7) (I,II)
CANCBIIO 553 Cancer Biol (2) (I)
CDB 550 Through the Looking Glass – From Stem Cells to Tissues and Organs (4) (II)
CDB 683-685 Organogenesis of Complex Tissues (3) (I)
CHE 519 Pharmaceutical Engineering (3) (II)
CHE 528 Chemical Reactor Engineering (3) (I)
CHE 530 Intro Bioinf Sys Bio (3) (I)
CHE 538 Statistical and Irreversible Thermodynamics (3)
CHE 542 Intermediate Transport Phenomena (3)
CHE 696 Selected Topics (2) (I)
EECS 414 Intro to MEMS (4) (I)
EHS 583 Radiation Biology (3) (I)
MCDB 611 Excitable Membranes (1) (I)
MECHENG 553 Microele Sys (3) (II-alternate years)
MECHENG 599.002 Cellular Engineering (3) (I)
MEDCHEM 409 Drug Assay (3) (I)

KEY AND ADDITIONAL NOTES:
Course Department and Number Course Name (# of credits) (term offered)

Terms:  I- fall, II - winter, III - spring-summer, IIIa - spring half, IIIb summer half

Every effort is made to make sure that the course offering is correct, but students should refer to the Schedule of Classes or the department’s website for the current offering.