

National Institute of Health Training Program in Quantitative Biology and Physiology

There are two core required courses in quantitative biology and physiology for all trainees and each has a laboratory component (**BE505: Molecular Bioengineering I** and **BE706: Quantitative Physiology**). Both are required of all BME students as well.

The remaining required courses are in areas of quantitative and engineering-based systems biology and physiology and in measurement techniques. Table A provides an overview of these remaining courses.

TABLE A: QUANTITATIVE AND ENGINEERING BASED BIOLOGY AND PHYSIOLOGY COURSES

Molecular and Genetic Engineering	Cellular-to- Tissue Level Engineering	Tissue- to-Organ Level Engineering	Scale-Independent Analysis / Modeling	Measurement Techniques
BE 506: Molecular Bioengineering II BE 560: Biomolecular Architecture BE 561: DNA and Protein Sequence Analysis <u>BE 567: Nonlinear Dynamics in Biological Systems</u> <u>BE 700: Mechanisms & Models of Cellular Regulation</u> BE 764: Biophysics of Large Molecules BE767: Protein & Genomic Systems Eng. BE 777: Computational Genomics BE 768: Biological Data Base Design BI 645: Cellular / Molecular Neurophysiology BI 575: Techniques in Cellular / Molecular Neurophysiology	BE 523: Mechanics of Biomaterials <u>BE 775: Mechanisms & Models of Cellular Regulation</u> <u>BE 707: Quantitative Studies of Excitable Cells</u> BE 726: Biomaterials & Tissue Eng I BE 727: Biomaterials & Tissue Eng II BE 521 Continuum BioMechanics BE 722 Continuum Biomechanics and Biofluid Dynamics BI 645: Cellular / Molecular Neurophysiology BE 550: Bioelectromechanics <u>BE 567: Nonlinear Dynamics in Biological Systems</u> <u>BE563: Cellular and Molecular Systems Analysis</u>	<u>BE 508: Quantitative Studies of Respiratory and Cardiovascular Systems</u> BE 509: Quantitative Physiology of the Auditory System <u>BE 570: Introduction to Computational Vision</u> BE 710: Neural Plasticity and Perceptual Learning <u>BE 567: Nonlinear Dynamics in Biological Systems</u> BE 726: Biomaterials & Tissue Eng I BE 727: Biomaterials & Tissue Eng II BE 523: Mechanics of Biomaterials BE 521 Continuum BioMechanics BE 722 Continuum Biomechanics and Biofluid Dynamics	<u>BE 567: Nonlinear Dynamics in Biological Systems</u> <u>BE 703: Numerical Methods and Modeling in BME</u> <u>BE 736: Biomedical Transport</u> <u>BE 740: Parameter Estimation and System Identification in BME</u> BE 747: Advanced Signals and Systems for BME MA 565: Math Models in the Life Sciences	BE 523: Mechanics of Biomaterials BE 511: Biomedical Instrumentation BE 512: Biomedical Instrument Design BE 515: Introduction to Medical Imaging BE 537: Biomedical and Biochemical Microsystems BE 726: Biomaterials & Tissue Eng I BE 727: Biomaterials & Tissue Eng II BE 765: Biomedical Optics and Biophotonics BI 575: Techniques in Cellular / Molecular Neurophysiology BE 500: Optical Microscopy of Biological Materials

At least two courses must be chosen from the underlined options as these courses place emphasis on quantitative and modeling based laboratory exercises. Trainees must select at least one course from 3 of the first 4 columns. This ensures that every trainee takes at least two courses synthesizing a quantitative and systems approach at two distinct scales of biology (eg., molecular-cell, cell-tissue, or tissue-organ) and a third course either at the third biological scale or a course (from Column 4) that cuts across multiple scales. Finally, all trainees must then select a course from Column 5 covering measurement techniques. This requirement ensures that every trainee is exposed to experimental methods at some level. Satisfying these selections results in 6 courses. Trainees then must take 2 additional free electives.

Satisfying the Requirements for the Ph.D. in BME. As QBP trainees select their courses they must be cognizant of the general course requirements for all BME students. These requirements consist of the same two required Core courses from above (BE505 and BE706) and six more electives. Selecting from Table A as described can easily be done in a fashion to satisfy Ph.D. requirements in BME also.