May 1, 2013

MEMORANDUM

TO: Faculty and graduate students within the Weldon School of Biomedical Engineering
FROM: BME Graduate Committee
RE: Course lists for core competency areas of new graduate curriculum

With the requirement of core course competencies, the graduate committee has prepared and attached some examples of acceptable courses for the Life Science, Other Engineering, and Quantitative core competency areas of the new BME graduate curriculum. These lists are by no means intended to be exhaustive. Compilation of lists of unacceptable courses and examples of acceptable courses is a work in progress. We expect these lists to be dynamic and under periodic review as the University Schedule of Classes is also dynamic. The following are up-to-date lists that will be maintained and available to students and faculty members from the BME Graduate Office and on the Graduate Programs webpage.

Typically 3-credit courses are approved for core competencies. However, as you will see from the course lists below, the Graduate Committee also has approved some 1 and 2-credit courses since the new curriculum began because certain graduate courses in Life Sciences and Medicine are offered only in 1 or 2-credit format. If you decide to take courses for only 1 or 2 credits, you still need to meet the required number of credits for each core competency.
Courses which will NOT count for any core competency:

- Seminar courses
- Methodology/laboratory courses (except where allowed by RET Module system [https://engineering.purdue.edu/BME/Academics/BMEGraduateProgram/Courses/Modules/RET_Modules.pdf](https://engineering.purdue.edu/BME/Academics/BMEGraduateProgram/Courses/Modules/RET_Modules.pdf))
- ALL courses currently offered in ENE (Engineering Education)

**ABE 591** Introduction to Biophysics (3 cr.)
**BIOL 511** Intro to X-ray Crystallography (3 cr.); approved as life science course only if it was taken prior to Spring 2009 offering
**BME 595 / MGMT 590** Biomedship (3 cr.)
**BME 595** Regulatory Issues Surrounding Approval of Biomedical Devices (3 cr.)
**BME 595** Regulatory Compliance for Biomedical Devices (3 cr.)
**BME 595** Preclinical and Clinical Studies (2 cr.)
**CHE 685** Educational Methods in Engineering (3 cr.)
**CS 515** Numerical Linear Algebra (3 cr.)
**EAS 557** Introduction to Seismology (3 cr.)
**HORT 590** Scanning Electron Microscopy: Principles & Practical Application (3 cr.)
**PHAD 690** Regulatory Issues (1-3 cr.)
**PHYS 590** Reading and Research (1-3 cr.)
**PSY / IE 577** Human Factors in Engineering (3 cr.)
**PSY 600** Statistical Inference (3 cr.)
**PSY 601** Correlation and Experimental Data (3 cr.)—Students with PSY 601 on approved plan of study from Spring 2009 and prior may count this course as 600-level quantitative
**SLHS 502** Fundamentals of Speech Production and Perception (3 cr.)
**SOC 573** Human Side of Medicine (3 cr.)
**STAT 503** Stat Methods Biology (3 cr.)
**STAT 511** Stat Methods (3 cr.)
**STAT 512** Applied Regression Analysis (3 cr.)
**STAT 516** Basic Probability and Applications (3 cr.)
Examples of Approved Ethics courses

Offered at West Lafayette
BME 595 Bioethics in Biomedical Engineering (1 cr.)
ENTM 612 Responsible Conduct in Research (1 cr.)
GRAD 612 Responsible Conduct in Research (1 cr.)

Offered at IUPUI or IUSM
G504 Intro to Research Ethics (2 or 3 cr.)
G505 Responsible Conduct of Research (1 cr.)
### Examples of Approved BME Courses (offered at West Lafayette)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ABE 680</td>
<td>Bioseparations and Bioprocess Engineering: Principles, Practice and Economics</td>
<td>3 cr.</td>
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<tr>
<td>BME 521</td>
<td>Biosensors: Fundamentals and Applications</td>
<td>3 cr.</td>
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<td>BME 528</td>
<td>Measurement and Stimulation of the Nervous System</td>
<td>3 cr.</td>
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<td>BME 530</td>
<td>Medical Imaging and Diagnostic Technologies</td>
<td>3 cr.</td>
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<td>BME 540</td>
<td>Biomechanics</td>
<td>3 cr.</td>
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<td>BME 541</td>
<td>Biomedical Fluid Dynamics</td>
<td>3 cr.</td>
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<td>BME 551</td>
<td>Tissue Engineering</td>
<td>3 cr.</td>
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<td></td>
<td><em>cannot count toward minimum POS requirements if BME 59500 Principles of Tissue Engineering has already been taken.</em></td>
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<tr>
<td>BME 553</td>
<td>Introduction to Biomedical Optics</td>
<td>3 cr.</td>
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<td>BME 581</td>
<td>Fundamentals of MEMS and Micro-Integrated Systems</td>
<td>3 cr.</td>
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<td>BME 583</td>
<td>Biomaterials</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Analog Integrated Circuit Design for Biomedical Applications</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Engineering the Experiment</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Multivariate Analysis in Biostatistics</td>
<td>3 cr.</td>
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<td><em>approved for use as 500-level Quantitative or BME or Other Engineering course.</em></td>
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<tr>
<td>BME 595</td>
<td>Principles of Tissue Engineering</td>
<td>3 cr.</td>
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<td></td>
<td><em>cannot count toward minimum POS requirements if BME 551 has already been taken.</em></td>
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<td>BME 595</td>
<td>Biomedical Signal Processing</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Kinematics and Dynamics of Human Motion</td>
<td>3 cr.</td>
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<tr>
<td>BME 595</td>
<td>Nonlinear Dynamics of Biological Systems</td>
<td>3 cr.</td>
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<tr>
<td>BME 595</td>
<td>Healthcare Systems Engineering</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Light-Tissue Interaction for Tissue Spectroscopy/Imaging</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Advanced Instrumentation and Application of Particle Spectrometry</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Neuromorphic Systems and Synthetic Vision</td>
<td>3 cr.</td>
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<td>BME 595</td>
<td>Continuum Models in Biomedical Engineering</td>
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<td>BME 595</td>
<td>Healthcare Operations Research</td>
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<td>BME/BIOL595</td>
<td>Neural Mechanisms in Health and Disease</td>
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<td>BME 626</td>
<td>Engineering Nanomedical Systems</td>
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<td>BME 630</td>
<td>Biomedical Imaging Systems</td>
<td>3 cr.</td>
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<td>BME 695</td>
<td>Advanced Biomaterials (Also listed as Biomaterials Engineering: Design Constraints and Applications)</td>
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<td>BME 695</td>
<td>Surface Science Techniques For Biomedical And Chemical Applications</td>
<td>3 cr.</td>
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<td>BME 695 / IPPH 690</td>
<td>Polymers in Pharmaceutical and Biological Systems</td>
<td>3 cr.</td>
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<tr>
<td>BME 695</td>
<td>Engineering Nanomedical Systems</td>
<td>3 cr.</td>
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<tr>
<td>BME 695</td>
<td>Stochastic Optimization and Control in Clinical Decision Making</td>
<td>3 cr.</td>
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<tr>
<td>BME 695</td>
<td>Dynamic Programming Medical Decision Making</td>
<td>3 cr.</td>
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<td>BME 695</td>
<td>Advanced Tissue Engineering</td>
<td>3 cr.</td>
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<tr>
<td>BME 695 / ME 697</td>
<td>Biomedical Fluid Dynamics</td>
<td>3 cr.</td>
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**BME 695** Mechanobiology (3 cr.)
**BME 695** Magnetic Resonance Imaging (600-level; 3 cr.)
**BME 695** Nanobiomechanics (600-level; 3 cr.)
**BME 695** Computational Health Informatics (600-level; 3 cr.)
**BME 695** Cardiovascular Biomedical Engineering (600-level; 3 cr.)
**BME 695** Advanced Controls in BME & Healthcare Application (3 cr.)

**CHE 697** Protein Engineering (this course was approved for a 600-level BME Course for the Spring 2013 semester only. 3 cr.)

**BME 695 / ECE641** Digital Image Processing II (3 cr.)

**(Special Cases)**

**BME 595** Hydrogel Synthesis and Characterization Laboratory Module (1 cr.); approved for use as 500-level BME or Other Engineering course only when taken as RET module.

**BME 595** Functional MRI Applications Laboratory Module (1 cr.); approved for use as 500-level BME or Other Engineering course only when taken as RET module.

**BME 595** Stem Cells for Tissue Engineering Laboratory Module (1 cr.); approved for use as 500-level Life Science course only when taken as RET module. Does not count as a BME course.

**BME 595** Technical Writing: Keys to Biomedical Engineering Publication (1 cr.)

**BME 658 / BMS 635** Cell and Tissue Culture: Techniques and Application Module (1 cr.); approved for use as 500-level Life Science course only when taken as RET module. This does not count as a BME course.
Examples of Approved Life Science courses (offered at West Lafayette)

ANSC 595 Stem Cell Biology (3 cr.)
BCHM 561 General Biochemistry I (3 cr.)
BCHM 562 General Biochemistry II (3 cr.)
BCHM 630 Proteomics & Metabolomics (2 cr.)
BCHM 659 Structure, Function of Proteins (1 cr)
BCHM 660 Structure, Function of Nucleic Acids (1 cr)
BCHM 664 / BIOL 600 Bioenergetics (2 cr)
BCHM 665 Enzyme Mechanisms (1 cr)
BCHM 668 Gene Regulation in Eukaryotes (approved as 500-level; 1 cr.)
BCHM 693 Molecular Signal Transduction (2 cr.)
BIOL 516 Molecular Biology of Cancer (3 cr.)
BIOL 517 The Molecular Biology of Proteins (2 cr.)
BIOL 529 Bacterial Physiol (3 cr.)
BIOL 537 Immunobiol (3 cr.)
BIOL 538 Mol Cell and Dev Neuro (3 cr.)
BIOL 541 Genetic Biol (3 cr.)
BIOL 559 Endocrinology (3 cr.)
BIOL 562 Neural Systems (3 cr.)
BIOL 573 Molecular Biol of Animal Cells (3 cr.)
BIOL 592 Evolution of Behavior (3 cr.)
BIOL 595 Developmental Biology (3 cr.)
BIOL 599 Quantitative Physiology (3 cr.)
BIOL 602 Cellular Neurobiology (3 cr.)
BIOL 620 Advanced Cell Biology (3 cr.)
BME 595/BIOL 595 Neural Mechanisms in Health and Disease (3 cr.)
BMS 501 Anatomy I (3.5 cr.)
BMS 502 Anatomy II (3 cr.)
BMS 507 Princ of Cell Tissue Design I (3 cr.)
BMS 508 Princ of Cell Tissue Design II (3 cr.)
BMS 510 Human Ana Biome Sci Eng (4 cr.)
BMS 517 Cardiovascular Physiology (1.5 cr.)
BMS 517 Respiratory/Renal Physiology (1.5 cr.)
BMS 517 Endocrine/Reproduction Physiology (1 cr.)
BMS 520 Syst Mammalian Physiology (3 cr.)
BMS 521 Syst Mammalian Physiology II (4 cr.)
BMS 525 Principles of Neuroanatomy (2 cr.)
CHM 538 Molecular Biotechnology (3 cr.)
CHM 632 Membrane Structure/Function (3 cr.)
CHM 648 Bioinorganic Chem. (3 cr.)
CHM 634 Biochemistry: Structural Aspects (3 cr.)
CHM 651 Adv Organ Chem. (3 cr.)
CHM 652 Synthetic Organic Chem (3 cr.)
CHM 696 Aspects of Drug-Design and Concepts of Medicinal Chemistry (approved as 500-level; 3 cr.)
CHM 696 Bio-Nanotechnology (3 cr.)
CHM 696 Materials Chemistry of Drug Delivery Systems (3 cr.)
CHM 696 Materials Design and Performance of Drug Delivery Systems (3 cr.)
HK 566 Biomedical Principles of Health Promotion (3 cr.)
HK 567 Epidemiology (3 cr.)
HSCI 560 Toxicology (3 cr.)
IPPH 583 Advanced Biopharmaceutics (3 cr.)
MCMP 690 Molecular Targets: Cancer (2 cr.)
PSY 627 Advanced Topics in Visual Perception (3 cr.)
SLHS 519 Neural Basis of Hearing (3 cr.)
SLHS 606 Experimental Phonetics (3 cr.)
**Examples of Approved Additional Engineering courses (offered at West Lafayette)**

ABE 560  Biosensors: Fundamentals and Applications (3 cr.)
ABE 580  Process Eng of Renew Resources (3 cr.)
ABE 591  Quantitative Systems Biology (3 cr.)
ABE 591  Nonlinear Dynamics of Biological Systems (3 cr.)
ABE 601  Applied Finite Element Analysis (3 cr.)
ABE 680  Biosep & Bioprocess Eng: Principles, Practice & Economics (3 cr.)
CHE 525  Biochemical Engineering (3 cr.)
CHE 540  Transport Phenom (3 cr.)
CHE 543  Polymer Reaction Kinetics (3 cr.)
CHE 544  Structure and Physical Behavior of Polymeric Materials (3 cr.)
CHE 668  Collodial and Interfacial Phenom (3 cr.)
CHM 621  Advanced Analytical Chemistry (3 cr.)
CHM 624  Particle Spectroscopy (3 cr.)
ECE 511  Psychophysics (3 cr)
ECE 513  Diffraction, Fourier Optics, and Imaging (3 cr)
ECE 526  Fundamentals of MEMS and Micro-Integrated Systems (3 cr.)
ECE 528  Measurement and Stimulation of the Nervous System (3 cr.)
ECE 538  Digital Signal Processing I (3 cr.)
ECE 559  MOS VLSI Design (3 cr.)
ECE 580  Introduction to Optimization (3 cr.)
ECE 595  CMOS Analog IC Design (3 cr.)
ECE 595  Digital System Design Automation (3 cr.)
ECE 600  Random Variables and Signals (3 cr.)
ECE 602  Lumped System Theory (3 cr.)
ECE 604  Electromag Fld Theo (3 cr.)
ECE 606  Solid State Devices I (3 cr.)
ECE 608  Computational Models & Methods (3 cr.)
ECE 620  Biomedical Imaging Systems (3 cr.)
ECE 629  Intro to Neural Networks (3 cr)
ECE 637  Digital Image Processing I (3 cr.)
ECE 645  Estimation Theory (3 cr)
ECE 649  Speech Processing by Computer (3 cr.)
ECE 662  Pattern Recognition and Decision-Making Processes (3 cr.)
ECE 695  Nanophotonics (3 cr)
ECE 695  Magnetic Resonance Imaging (600-level; 3 cr.)
ECE 695  System-on-Chip Design (600-level, 3 cr.)
IE 535 Linear Programming (3 cr.)
IE 536 Stochastic Models in Operations Research (3 cr.)
IE 545 Engineering Economic Analysis (3 cr.)
IE 579 Designs and Control of Modern Production Systems (3 cr.)
IE 580 Systems Simulation (3 cr.)
IE 634 Integer Programming (3 cr.)
IE 680 Advanced Simulation Design and Analysis (3 cr.)
ME 509 Intermediate Fluid Mechanics (3 cr.)
ME 513 Engineering Acoustics (3 cr.)
ME / CHE 517 Micro-and Nanoscale Physical Processes (3 cr.)
ME 559 Micromechanics of Materials (3 cr.)
ME 569 Mech Behavior of Materials (3 cr.)
ME 577 Kinematics of Human Motion (3 cr.)
ME 580 Non-linear Engineering Systems (3 cr.)
ME 585 Instrumentation for Engineering Measurements (3 cr.)
ME 586 Microprocessors in Electromechanical Systems (3 cr.)
ME 587 Engineering Optics (3 cr.)
ME 612 Continuum Mechanics (3 cr.)
ME 613 Advanced Engineering Acoustics (3 cr.)
ME 664 Vibrations of Continuous Systems (3 cr.)
ME 687 Laser Diagnostics for Reacting Flows (500-level; 3 cr.)
ME 697 Micro and Nano Fluid Mechanics (3 cr.)—approved for 1st offering only in fall 2008; Grad Com will review again after 1st offering.
MSE 547 Introduction to Surface Science (3 cr.)
MSE 556 Fracture of Materials (3 cr.)
MSE 597 Physical Properties of Crystals (3 cr.)
MSE 597 Polymer Synthesis (3 cr.)
MSE 597 Soft Materials (3 cr.)—approved for 1st offering only in spring 2009; Grad Com will review again after 1st offering
MSE 640 TEM and Crystalline Imperfections (600-level; 3 cr.)
MSE 697 Principles and Methods of Nanofabrication (3 cr.)
NUCL 570 Fuzzy Approach in Engineering (3 cr.)
Examples of Acceptable Quantitative courses (offered at West Lafayette)

BME 595 Multivariate Analysis in Biostatistics (3 cr.)
BME 595 Engineering the Experiment (3 cr.)
BME 695 / ECE641 Digital Image Processing II (3 cr.)
CHE 630 Applied Mathematics for Chemical Engineers (3 cr.)
ECE 600 Random Variables and Signals (3 cr.)
ECE 602 Lumped System Theory (3 cr.)
IE 533 Industrial Applications of Statistics (3 cr.)
MA 510 Vector Calculus (3 cr.)
MA 511 Linear Algebra with Applications (3 cr.)
MA 514 Numerical Analysis (3 cr.)
MA 525 Intro to Complex Analysis (3 cr.)
MA 527 Adv Math Eng Phys I (3 cr.)
MA 528 Adv Math Eng Phys II (3 cr.)
ME 580 Nonlinear Engineering Systems (3 cr.)
ME 597 Introduction to Continuum Physics & Applied Mathematics
ME 612 Continuum Mechanics (3 cr.)
MGMT 676 Convex Optimization (3 cr.)
PHYS 600 Methods of Theoretical Physics I (3 cr.)
PHYS 601 Methods of Theoretical Physics II (3 cr.)
STAT 514 Experimental Design (3 cr.)
STAT 517 Statistical Inference (3 cr.)
STAT 519 / MA 519 Introduction to Probability (3 cr.)
STAT 528 Intro to Mathematical Stat (3 cr.)
STAT 532 Elements of Stochastic Processes (3 cr.)
STAT 553 Theory of Linear Models and Analysis of Experimental Design (3 cr.)
STAT 598 Statistical Methods for Bioinformatics and Computational Biology (3 cr.)
IUPUI or IUSOM campus courses

Exception to 3-credit course requirement for core competency areas: Medical school courses that are offered for 1 or 2 credits on the IU School of Medicine campus and which have been approved by the BME Graduate Committee may be counted toward the BME graduate curriculum for the life science core competency area. These medical school courses must be submitted to the Graduate Committee following usual course petition procedures in order to be considered for approval.

Courses which will NOT count for any core competency:
- Seminar courses
- Special topics/special assignment courses
- Methodology/laboratory courses
- C696 Bioanalytical Chemistry
- G504 Introduction to Research

Examples of Approved Life Science courses (offered at IUPUI or IUSM)
- BIOC 500 Introductory Biochemistry (3 cr.)
- BIOC B835 Neurochem (3 cr.)
- BIOL 507 Principles of Molecular Biology (3 cr.)
- BIOL 516 The Molecular Biology of Cancer (3 cr.)
- BIOL 568 Regenerative Biology and Medicine (3 cr.)
- BIOL 571 Developmental Neurobiol (3 cr.)
- BIOL 697 Molecular and Cell Bone Biology (3 cr.; 500-level) – Note 1: This course is approved as a 500-level Life Sciences course. Note 2: Students cannot use both this course and G819 (Basic Bone Biology) for their POS.
- D501 Functionally-Oriented Human Gross Anatomy (5 cr.)
- D502 Basic Histology (4 cr.)
- D527 Graduate Neuroanatomy (3 cr.)
- F708 Cardiac & Coronary Phys of Exercise (1 cr., 600-level)
- F715 Physiology of the Coronary Circulation (1 cr., 600-level)
- F761 Molecular and Cellular Physiology of Ion Transport (1 cr; 600-level)
- G715 Biomedical Science I - Biochemical Basis of Biological Processes (3 cr; 500-level)
- G716 Biomedical Science II- Molecular Biology and Genetics (3 cr; 500-level)
- G717 Biomedical Science III - Cellular Basis of Systems Biology (3 cr; 500-level)
- G804 Cellular and Molecular Biology (3 cr; 500-level)
- G817 Molecular Basis of Cell Structure and Function (2 cr; 500-level)
- G818 Integrative Cell Biology (3 cr; 600-level)
- G819 Basic Bone Biology (3 cr; 600-level) - Note 1: Students cannot use both this course and BIOL 697 (Molecular and Cell Bone Biology) for their POS.
- G852 Concepts of Cancer Biology: Cancer Signaling (2 cr; 500-level)
PSY I-545 Psychopharmacology (3 cr.)
Q580 Basic Human Genetics (3 cr)
Q601 Medical Genetics (2 cr; 500-level)

Examples of Approved Engineering courses (offered at IUPUI or IUSM)*
BME 595 Drug Delivery (3 cr.)
BME 595 Cellular Mechanotransduction (3 cr.)
BME 595 Molecular and Cellular Biomechanics (3 cr.)
BME 595 Polymers for BME applications (3 cr.)
BME 595 Tissue Engineering (3 cr.)
BME 595 Engineering Principles of Biomolecular Interactions (3 cr.)
BME 595 Musculoskeletal Biology and Mechanics (3 cr.)
BME 695 Advanced Biomedical Polymers (3 cr.)
ECE 569 Intro to Robotic Systems (3 cr.)
ECE 600 Random Variables and Signals (3 cr.)
*BME courses may also count as meeting the BME Core Competency requirement

Examples of Approved Quantitative courses (offered at IUPUI or IUSM)
MATH 510 Vector Calculus (3 cr.)
MATH 511 Linear Algebra and Applications (3 cr.)
MATH 559 Applied Computational Methods I (3 cr.)
STAT 514 Design of Experiments (3 cr.)
STAT 519 Introduction to Probability (3 cr.)
STAT 524 Applied Multivariate Analysis (3 cr.)
STAT 532 Elements of Stochastic Processes (3 cr.)