**MS Biomedical Engineering Curriculum**

**Program Requirements *Advisor approval required for electives.***

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|  |  | **Term Taken** | **Advisor initials (for electives)** |
| **Core Requirements** | BIO 624 Found. Biomedical Physiology (3 credits) |  |  |
| BME 553 Cell and Tissue Biology (3 credits) |  |  |
| BME 570 Biomedical Signal Processing (3 credits) |  |  |
| Key Elective (select one)   * Biomaterials (BME 655, 3 credits)\_\_\_\_\_\_\_ * Medical Imaging (BME 659, 3 credits) \_\_\_\_\_\_\_ * Biomechanics (BME 651, 3 credits)\_\_\_\_\_\_ |  |  |
| **Thesis Track**  (30 credits total) | Elective 1 (3 credits) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Elective 2 (3 credits) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Elective 3 (3 credits) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Thesis credits (BME 699, 9 credits total): |  |  |
| **Design Track**  (33 credits total) | BME 658 Medical Device Design (3 credits) |  |  |
| BME 674 Biomedical Design Project I (3 credits) |  |  |
| BME 675 Biomedical Design Project II (3 credits) |  |  |
| MGT 543 Entrepreneurship (3 credits). |  |  |
| Elective 1 (3 credits) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Elective 2 (3 credits) \_\_\_\_ |  |  |
| Elective 3 (3 credits)\*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| **Course Track**  (36 credits total) | BME 580 Biomedical Instrumentation (4 credits) |  |  |
| ESC 720 Research Communications or elective (3 credits) |  |  |
| BME 758 Medical Device (2 credits) or BME 658 |  |  |
| Elective 1 (3 credits) |  |  |
| Elective 2 (3 credits) |  |  |
| Elective 3 (3 credits) |  |  |
| Elective 4 (3 credits) |  |  |
| Elective 5 (3 credits)\* |  |  |

**Recommended schedule for full-time students**

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|  |  | **Design Track (33 credits)** | **Thesis Track (30 credits)** |
| Year 1 | Fall | BME 553 Cell and Tissue Biology  BME 570 Biomedical Signal Processing  Elective 1 or Key Elective – 3 credits | BME 553 Cell and Tissue Biology  BME 570 Biomedical Signal Processing  Elective 1 or Key Elective – 3 credits |
|  | Spring | BIO 624 Biomedical Physiology  BME 658 Medical Device Design  Elective 1 or Key Elective – 3 credits | BIO 624 Biomedical Physiology  Elective 1 or Key Elective – 3 credits  Thesis – 3 credits |
|  | Summer | Project or internship (optional) | Thesis research |
|  |  |  |  |
| Year 2 | Fall | BME 674 Biomedical Design Project I  Elective 2 – 3 credits  Elective 3 – 3 credits\* | Elective 2 – 3 credits  Elective 3 - 3 credits  Thesis - 3 credits |
|  | Spring | BME 675 Biomedical Design Project II  MGT 543 Entrepreneurship | Thesis – 3 credits |

\* BUS 615 Entrepreneurship Tool Kit can substitute for one elective if completing the Entrepreneurship Certificate

(see other side🡪)

### MS Biomedical Engineering Electives. Electives must be selected from either the list of graduate BME courses, or selected from the list shown below. Electives must be selected with advisor approval. It is recommended that students take a course sequence in a specific area in order to build depth of knowledge.  Elective courses outside of this list must be approved by petition to the faculty of the ChBME Department.

### Signal, Image, and Data Analysis:  BME 659 Medical Imaging, PHY 565 Image Processing, PHY 530 Introduction to Medical Physics, PHY 535 Radiation Therapy Physics, CHE 594 Data Analysis and Rectification, IME 510 Advanced Engineering Statistics, IME 520 Applied Engineering Design, PHY 550 Optics, PHY 660 Electronics

* Biomechanics: BME 651 Biomechanics, MCE 695 Biomechanics and Control of Human Movement, MCE 695 Control of Prosthetics, CHE 594 Biofluid Mechanics, CVE 512 Finite Element Analysis I, CVE 612 Finite Element Analysis II, CVE 513 Advanced Strength of Materials, CVE 604/ESC 794 Elasticity
* Tissue Engineering: BME 655 Biomaterials, BME 651 Biomechanics, CHE 586 Fundamentals of Polymers, BME 635 Tissue Engineering
* Materials synthesis/characterization/nanotechnology: CHE 586 Fundamentals of Polymers, CHE 580 Advanced Materials Processing, EEC 514 Nanotechnology, CHE 602 Surface Phase Equilibria, BME 694 Interfacial Phenomena
* Bioprocessing: BME 694 Drug Discovery, Design, and Delivery, CHE 566 Biochemical Engineering, CHE 504 Advanced Chemical Reactor Design, CHE 506 Advanced Transport Phenomena, CHE 508 Advanced Separation Processes, CHE 502 Advanced Thermodynamics, CHE 603 Fundamentals of Adsorption, CHE 606 Advanced Mass Transfer
* Instrumentation/Sensors/MEMs devices/Controls: BME 580 Biomedical Instrumentation, BME 694 Microfluidics, BME 625 Pharmaceutical Assay Development, BME 655 Biomaterials, EEC 515 Biosensors, Biofuel Cells, and BioMEMS, EEC 514 Nanotechnology, EEC 530 Digital Signal Processing, PHY 660 Electronics, EEC 645 Intelligent Control Systems,  CHE 594 Data Analysis and Rectification
* Software Engineering: EEC 525 Data Mining, EEC 517 Embedded Systems

**Preparatory Program**

Students who have an undergraduate background in a field other than engineering are required to have completed additional undergraduate coursework, including calculus through differential equations (ESC 250 or MTH 286) and multivariable calculus (MTH 283), one year of calculus-based physics (PHY 241 and 242), one semester of general chemistry with laboratory (CHM 261/266), and at least 9 credits of undergraduate engineering courses, selected from the following five options\*.

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| **Field of Specialization** | **Courses** |
| **Biomaterials and Tissue Engineering** | ESC 201 Statics, ESC 211 Strength of Materials, CVE 311 Strength of Materials Lab |
| **Biomechanics** | ESC 202 Dynamics1, ESC 211 Strength of Materials1, MCE 260 Kinematics |
| **Mechanical Design2** | ESC 201 Statics, ESC 211 Strength of Materials, MCE 260 Kinematics |
| **Imaging3** | EEC 310 and 311 (Electric Circuits I and II), EEC 383 Digital Systems, EEC 430 Digital Signal Processing |
| **General** | ESC 301 Fluid Mechanics, ESC 315 Electrical Engineering Concepts, CHE 306 Transport Phenomena, CHE 300 Chemical Engineering Principles |

Students may be admitted into the program prior to their completing these requirements. Students will only be permitted to enroll in graduate courses for which they have completed the prerequisites. These undergraduate credits will not count towards the 30/33 graduate hours required for the degree. A grade of B or better must be earned in each of the preparatory program courses. *\*ESC 152 (Matlab), MCE 180, 181 (CAE I/II) and ESC 350 (Linear Algebra) are strongly recommended in addition to the required preparatory coursework. These courses do not count towards the 9 required credits of undergraduate engineering coursework. 1These courses have ESC 201 as pre-requisite; in the absence of ESC 201, student must have completed PHY 241 (calculus-based) and additional study of the topic. 2MCE 180 and 181 strongly recommended for the Mechanical Design track. 3ESC 152 and ESC 350 strongly recommended for the Imaging track.*