**STRUCTURED OPTIONS WITH GEF CURRICULUM**
**for B.S.Bm.E. Electives**

GENERAL CONSTRAINTS FOR ELECTIVES

- A total of 21 credits of technical electives are required.
- At least 9 credits of the technical electives must be in engineering science courses.
- At least 3 credits must be in advanced science.
- At least 3 credits must be in life sciences.
- The final 6 credits may be from the engineering science, advanced science, or technical elective list.

## 1. Biomaterials.

Students enrolled in this track will receive rigorous education in materials, biomaterials, devices, implants, and tissue engineering. Material interaction with a living system needs to be considered for all devices or implants; such interactions can be modulated by the type of material or the type of processing applied to the materials to ensure their high biocompatibility and biofunctionality upon integration with biological systems. Materials in biological systems are used to enhance or replace a deteriorated biological function; understanding how the body responds to a material and how that response can be controlled is key to its use for development of devices. This specialized type of training will prepare graduates for success in specific health care careers (e.g., research and development activities for R&D programs related to advanced biomaterials for orthopedic applications for instance, support and development of novel biomaterials-based implant designs, drug-device combination products, drug delivery formulations and analytical test method development, etc.) in addition to helping the students looking to attend medical school.

*Track Requirement*

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|---|---|
| BMEG 482 | Tissue Engineering |

*Course Options*

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|---|---|
| BIOC 339 or AGBI 410 | Biochemistry |
| BMEG 480 | Cellular Machinery |
| CHE 461 | Polymer Science |
| CHE 462 | Polymer Processing |
| CHEM 234/ CHEM 236 | Organic Chemistry 2 |
| CHEM 310 | Instrumental Analysis |
| CHEM 335 | Methods of Structure Determination |
| MAE 241 | Statics |
| MAE 242 | Dynamics |
| MAE 243 | Mechanics of Materials |
| MAE 343 | Intermediate Mechanics of Materials |

**2. Biotechnology.**

Students enrolled in this track will receive rigorous education on the cross-section of biology and engineering through introduction and explanation of the physical principles that govern biological matter and processes and how those could be blended with engineering examples. Such foundation is required for instance for the development of new technologies for enhancing patient or doctor experiences in the clinic (e.g., through a point of care testing system) and require an understanding of the biological system and the engineering strategies that can be applied to those systems for both data collection and interpretation. This specialized type of training will prepare graduates for success in specific bio-related careers (e.g., research and development of biomedical technology, drug discovery, proteomics and genomics, point of care diagnosis, laboratory practices and design principles for biotechnology, bioreactor design and operation or biosensors etc.) in addition to helping students looking to attend medical school and health care professions.

*Track Requirement*

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|---|---|
| BIOC 339 or AGBI 410 | Biochemistry |

*Course Options*

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|---|---|
| BMEG 480 | Cellular Machinery |
| BIOL 219 | Living cell |
| BMEG 482 | Tissue Engineering |
| CHEM 234/ CHEM 236 | Organic Chemistry 2 |
| CHPR 440 | Clinical Research Methods and Practice |

**3. Bioelectronics and Biomedical Imaging.**

Students enrolled in this track will receive rigorous education in electrical engineering with focus on the development of biomedical instrumentation, biological signal processing and the acquisition and processing of images for diagnostic or therapeutic purposes. Biomedical instrumentation can range from sensors that monitor protein concentration and heart monitors, to latest developments in medical imaging systems. Biomedical engineers work on the development of such instruments and sensors but also means on how to interpret the information that is being collected. Bio-signal processing is used for both diagnosing a problem and monitoring that usage of a therapy applied to solve that problem is effective. The collection of imaging data inexpensively, quickly, and accurately is the key to understanding the basics of system evolution. Imaging such systems with techniques such as x-ray, ultrasound, magnetic resonance imaging, and computerized tomography will enhance not only the clinical analysis and medical intervention, but further provide a visual and fundamental representation of the function of biological systems. This specialized type of training will prepare graduates to pursue a wealth of career opportunities (e.g., clinical engineers, medical engineers, medical equipment experts, researchers in healthcare R&D centers, employs in healthcare services companies, medical laboratories, university laboratories, and equipment vendors, development of imaging tools and software, instrument modification for real-time image analysis, equipment design for high quality image acquisition and processing etc.) in addition to helping the ones looking to attend medical school.

*Track Requirement*

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| EE 223 | Electrical Circuits |

*Course Options*

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| CPE 271 | Introduction to Digital Logic Design |
| CHE 493 | Bionanotechnology |
| EE 251 | Digital Electronics |
| EE 327 | Signals and Systems 1 |
| EE 328 | Signals and Systems Lab |
| EE 329 | Signals and Systems 2 |
| EE 465 | Introduction to Digital Imaging |
| PHYS 313 | Circuits |

**4. Biomechanics.**

Students enrolled in this track will receive rigorous education on the motion and deformation of the body, tissues, cells or biomaterials used to replace or restore a body function. Studying how internal and external forces and deformations act on an inanimate "object" will provide insight to the deleterious impacts on a living system. The goal of biomechanics is to understanding how a living system (from cell to tissue to body) responds to forces or how forces can be used to enhance function and mobility. This specialized type of training will prepare graduates for success in specific health care and engineering careers (e.g., research and development activities for orthopedic applications, design and implementation of prosthetic designs, investigation of impact of forces on the cell behavior including proliferation, differentiation, and apoptosis, project engineers responsible for performance and analysis of biomechanical tests that enable new biomechanical research advances, researcher responsible for performing human subject testing in order to determine product performance, etc.) in addition to helping students looking to attend medical school.

*Track Requirement*

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|---|---|
| MAE 241 | Statics |

*Course Options*

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|---|---|
| ATTR 219 | Anatomy |
| BIOC 339 or AGBI 410 | Biochemistry |
| MAE 242 | Dynamics |
| MAE 243 | Mechanics of Materials |
| MAE 343 | Intermediate Mechanics of Materials |
| PHYS 314 | Modern Physics |

**5. Medical and Health Informatics.**

Students enrolled in this track will receive rigorous education in the application of mathematics, statistics and computer analysis to medical information. The compilation and analysis of data including images, gene sequencing, and record databases can be used to determine for instance therapy processes, treatment/response relationships, and create new analysis processes. Further, the application of math to the engineering processes allows for the development of better

treatments and analysis for improved medical care strategies and approaches as well as how to create, maintain and process electronic health records, help ensure data privacy and security, implement medical procedure coding which complies with medical laws. This specialized type of training will prepare graduates to pursue a wealth of career opportunities (e.g., in epidemiology, pharmaceutical development, policy formulation, etc.) in addition to helping the ones looking to attend medical school.

| *Track Requirement* | |
|---|---|
| IENG 213 | Engineering Statistics |

| *Course Options* | |
|---|---|
| BIOC 339 or AGBI 410 | Biochemistry |
| BIOL 302 | Biometry |
| BIOL 324 | Molecular Genetics |
| BIOM 426 | Biometric System |
| BIOS 601 | Applied Biostatistics 1 |
| BIOS 602 | Applied Biostatistics Lab |
| CHE 531 | Math Methods |
| CHPR 440 | Clinical Research Methods and Practice |
| CS 111 | Introduction to data structures |
| FIS 450 | Computational Forensics |
| MATH 367 | Applied Mathematical Analysis |
| MATH 455 | Advanced Real Calculus |
| PHYS 211 | Mathematical Physics |