CURRICULUM

CORE COURSES (84 UNITS)

42 Units Artificial Intelligence Core

- Systems and Tool Chains for AI Engineering (12 units)
  Principles and key trade-offs in data collection and storage, data engineering, neural network engineering, framework architectures, and managing constraints

- Introduction to Machine Learning for Engineers (12 units)
  Introduction to machine learning with a special focus on engineering applications covers probability and Bayesian learning, generative and discriminative classification methods, supervised and unsupervised learning, neural networks, support vector machines, clustering, dimensionality reduction, regression, optimization, evolutionary computation and search.

- Introduction to Deep Learning for Engineers (6 units)

- Trustworthy and Ethical AI Engineering (12 units)
  Understanding of different kinds of threats and concerns for deploying AI solutions in the real world, an exposure to end-to-end deployment challenges, societal issues, and policy challenges in realizing these; and an exposure to best practices for avoiding these concerns.

12 Units AI Applications in BME

Hands-on experience in applying the fundamentals of AI/ML to problems in a variety of biomedical applications. Students will work in teams to design, develop, and evaluate an AI/ML system.

30 Units BME Core Electives

Choose one of the five BME cores:
- Biomaterials and Tissue Engineering
- Biomechanics
- Biomedical Imaging and Bioinformatics
- Neural Engineering
- Physiology and Cellular/Molecular Biology

PHYSIOLOGY (12 UNITS)

Choose one:
- 42-702 Advanced Physiology
- 03-763 Advanced Systems Neuroscience

May be waived if the student has previously taken a CMU-equivalent course in physiology. If waived, the student would instead take 12 additional free elective units of BME.

RESTRICTED ELECTIVE (12 UNITS)

12 Units of approved coursework in the BME graduate curriculum

ADDITIONAL REQUIREMENTS

Biomedical Engineering Seminar Attend seminar each semester the student is enrolled in the program: 42-701 (0 units) or 42-801 (3 units).

A minimum of 48 units from BME (42-XXX)

Total Units 108 units
BME CORE ELECTIVES

Students must take at least 30 units of the chosen courses within one of the BME cores. See sample course plans in the next section.

### Biomaterials and Tissue Engineering

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<td>Engineering Molecular Cell Biology</td>
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<td>Tissue Engineering</td>
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<td>Molecular and Micro-Scale Polymeric Biomaterials in Medicine</td>
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<td>42-670</td>
<td>Biomaterial Host Interactions in Regenerative Medicine</td>
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<td>42-673</td>
<td>Special Topics: Stem Cell Engineering</td>
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<td>Bio-nanotechnology: Principles and Applications</td>
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<td>Cell and Systems Modeling</td>
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<td>42-645</td>
<td>Cellular Biomechanics</td>
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### Biomedical Imaging and Bioinformatics

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<td>Neural signal processing</td>
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<td>Biological Imaging and Fluorescence Spectroscopy</td>
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<td>Computational Methods for Biological Modeling and Simulation</td>
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<td>(Bio) Medical Image Analysis</td>
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<td>86-765</td>
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### Physiology and Cellular/Molecular Biology

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<td>42-684</td>
<td>Principles of Immunoengineering and Development of Immunotherapy Drugs</td>
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<td>03-762</td>
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## SAMPLE COURSE PLANS

**BME core electives, restricted elective.**
Minimum number of BME (42-XXX) units: 48

### Biomaterials and Tissue Engineering

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### Biomechanics

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### Biomedical Imaging and Bioinformatics

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|       | Total:                                         | 36    |
## Neural Engineering

### First Year

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<th>Course</th>
<th>Units</th>
<th>Spring</th>
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<tbody>
<tr>
<td>14-813 Systems and Tool Chains for AI Engineering</td>
<td>12</td>
<td>TBD Introduction to Deep Learning for Engineers</td>
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<td>18-661 or 24-787 Introduction to Machine Learning for Engineers</td>
<td>12</td>
<td>TBD Trustworthy and Ethical AI Engineering</td>
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<td>42-702 Advanced Physiology</td>
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## Physiology and Cellular/Molecular Biology

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