Department of Biomedical Engineering

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Biomedical Engineering Overview

Biomedical engineering education at Carnegie Mellon University reflects the belief that a top biomedical engineer must be deeply trained in both a traditional engineering practice and biomedical sciences. The unique additional major program leverages extensive collaborations with sister departments in the College of Engineering and with major medical institutions in Pittsburgh. This collaborative approach, combined with a rigorous engineering education, confers unique depth and breadth to the education of Biomedical Engineering graduates.

Students who elect Biomedical Engineering as a major must also declare a major in one of the traditional engineering disciplines: Chemical Engineering, Civil & Environmental Engineering, Electrical & Computer Engineering, Materials Science & Engineering, or Mechanical Engineering.

The curriculum, demanding but readily feasible to complete in four years, is highly rewarding to motivated students.

Common Requirements for the Additional Major

The Biomedical Engineering additional major program takes advantage of curricular overlaps between Biomedical Engineering and traditional engineering majors, such that the dual major can be completed in four years with only a modest increase in course requirements. The requirements for Biomedical Engineering consist of the core, the tracks, and the capstone design course. The core exposes students to basic facets of biomedical engineering to lay a foundation. The tracks allow students to build depth in a specific aspect of biomedical engineering. The capstone design (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/Resources/undergrad_design.html) project engages students in teamwork to develop real-world applications.

The additional major in Biomedical Engineering should be declared at the same time when declaring a traditional engineering major.

Course Requirements for the Additional Major

Minimum units required for additional major: 93–102

Students majoring in Biomedical Engineering must meet three sets of requirements:

1. Biomedical Engineering (BME)
2. A traditional engineering discipline, and

The Quality Point Average (QPA) for courses that count toward the additional major must be 2.00 or better. No course taken on a pass/fail or audit basis may be counted toward the additional major.

The course requirements for the BME portion of the additional major are as follows:

Core Courses (all required)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology- Fall and Spring</td>
<td>9</td>
</tr>
<tr>
<td>or 03-151</td>
<td>Honors Modern Biology</td>
<td></td>
</tr>
<tr>
<td>42-101</td>
<td>Introduction to Biomedical Engineering- Fall and Spring</td>
<td>12</td>
</tr>
<tr>
<td>42-201</td>
<td>Professional Issues in Biomedical Engineering- Fall and Spring</td>
<td>3</td>
</tr>
<tr>
<td>42-202</td>
<td>Physiology- Fall and Spring</td>
<td>9</td>
</tr>
<tr>
<td>42-203</td>
<td>Biomedical Engineering Laboratory- Fall and Spring</td>
<td></td>
</tr>
<tr>
<td>42-302</td>
<td>Biomedical Engineering Systems Modeling and Analysis- Fall and Spring</td>
<td>9</td>
</tr>
<tr>
<td>42-401</td>
<td>Foundation of BME Design-Fall*</td>
<td>6</td>
</tr>
<tr>
<td>42-402</td>
<td>BME Design Project- Spring</td>
<td>9</td>
</tr>
</tbody>
</table>

* Also known as 03-206 for Health Professions Program (http://www.cmu.edu/hpp/) students.

# 42-401 serves as the precursor/pre-requisite for 42-402 BME Design Project.

Tracks (Completion of one track is required)

- Biomaterials and Tissue Engineering (BMTE) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/bmte_track.html)
- Biomechanics (BMEC) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/bmec_track.html)
- Biomedical Signal and Image Processing (BSIP) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/bsip_track.html)
- Cellular and Molecular Biotechnology (CMBT) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/cmbt_track.html)
- Neuroengineering (Neuro) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/neuro_track.html)
- Self-Designed Biomedical Engineering (SBME) (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/sbme_track.html)

Biomaterials and Tissue Engineering (BMTE) Track

Overview

The BMTE track addresses issues at the interface of materials science, biology and engineering. The topics include the interactions between materials and cells or tissues, the effects of such interactions on cells and tissues, the design of materials for biological applications, and the engineering of new tissues.

Targets

The BMTE track is ideal for students interested in combining the education of Biomedical Engineering with Materials Science & Engineering or with Chemical Engineering. Both provide the necessary foundation in chemistry and/or materials science. Students of this track may develop careers in biotechnology, tissue engineering, biopharmaceuticals, and medical devices that leverage materials properties.

Requirements

In addition to the Biomedical Engineering core courses, students in the BMTE Track must take the following combination of three courses:

- One (1) Required BMTE elective
- Two (2) BMTE Electives (either Required or Additional)
BMTE Electives

Required BMTE Electives (must take one of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>42/27-411</td>
<td>Engineering Biomaterials- Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-612/27-520</td>
<td>Tissue Engineering- Spring</td>
<td>12</td>
</tr>
<tr>
<td>42-670</td>
<td>Special Topics: Biomaterial Host Interactions in Regenerative Medicine- Fall</td>
<td>12</td>
</tr>
</tbody>
</table>

Additional BMTE Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-320</td>
<td>Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td>42-613</td>
<td>Polymeric Biomaterials- Spring</td>
<td>9</td>
</tr>
<tr>
<td>42-620</td>
<td>Engineering Molecular Cell Biology- Fall</td>
<td>12</td>
</tr>
<tr>
<td>42-624</td>
<td>Biological Transport and Drug Delivery- Spring</td>
<td>9</td>
</tr>
<tr>
<td>42-673</td>
<td>Special Topics: Stem Cell Engineering- Fall, every other year</td>
<td>9</td>
</tr>
<tr>
<td>42-676</td>
<td>Bio-nanotechnology: Principles and Applications</td>
<td>9</td>
</tr>
<tr>
<td>42-x00</td>
<td>BME Research* or 39-500 Honors Research Project* or 42-6XX Clinical Course (Surgery for Engineers/Precision Medicine/ICU Medicine)</td>
<td>9-12</td>
</tr>
</tbody>
</table>

* The 42-x00 research project (42-200/300/400 Sophomore/Senior Biomedical Engineering Research Project OR 39-500 CIT Honors Research Project) must be on a BME topic that is aligned to the track, supervised or co-supervised by a BME faculty member, and conducted for 9 or more units of credit.

Some Special Topics and newly offered or intermittently offered courses may be acceptable as BMTE track electives. Students should consult with their BME advisors and petition the BME Undergraduate Affairs Committee for permission to include such courses as BMTE track electives.

Sample schedules can be found on the BMTE website (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/bmte_track.html) page on the BME website.

Biomechanics (BMEC) Track

Overview

The BMEC track addresses the application of solid or fluid mechanics to biological and medical systems. It provides quantitative understanding of the mechanical behavior of molecules, cells, tissues, organs, and whole organisms. The field has seen a wide range of applications from the optimization of tissue regeneration to the design of surgical and rehabilitation devices.

Targets

The BMEC track is ideally suited to the combined education of Biomedical Engineering and Engineering. Both provide the necessary foundation in the underlying physical principles and their non-Biomedical Engineering applications. This track may also appeal to students of Electrical & Computer Engineering who are interested in biomedical robotics. Education in biomechanics enables students to pursue careers in medical devices or rehabilitation engineering.

Requirements

In addition to the Biomedical Engineering core courses, students in the BMEC Track must take the following combination of three courses:

- One (1) Required BMEC Elective
- Two (2) BMEC Electives (either Required or Additional)

BMEC Electives

Required BMEC Electives (must take at least one of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>42-341</td>
<td>Introduction to Biomechanics- Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-645/24-655</td>
<td>Cellular Biomechanics- Intermittent</td>
<td>9</td>
</tr>
<tr>
<td>42-646</td>
<td>Molecular Biomechanics- Intermittent</td>
<td>9</td>
</tr>
<tr>
<td>42-648</td>
<td>Cardiovascular Mechanics- Spring</td>
<td>12</td>
</tr>
</tbody>
</table>

Additional BMEC Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-441/03-439</td>
<td>Introduction to BioPhysics- Fall</td>
<td>10</td>
</tr>
<tr>
<td>42-444</td>
<td>Medical Devices- Fall and Spring</td>
<td>9</td>
</tr>
<tr>
<td>42-447</td>
<td>Rehabilitation Engineering- Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-640/24-658</td>
<td>Image-Based Computational Modeling and Analysis- Spring</td>
<td>12</td>
</tr>
<tr>
<td>42-643</td>
<td>Microfluidics- Intermittent</td>
<td>12</td>
</tr>
<tr>
<td>42-647</td>
<td>Continuum Biomechanics: Solid and Fluid Mechanics of Physiological Systems</td>
<td>12</td>
</tr>
<tr>
<td>42-x00</td>
<td>BME Research* or 39-500 Honors Research Project* or 42-6XX Clinical Course (Surgery for Engineers/Precision Medicine/ICU Medicine)</td>
<td>9-12</td>
</tr>
</tbody>
</table>

The BSIP track addresses biomedical phenomena based on the information embedded in sensor-detected signals, including digital images and nerve electrical pulses. Students in this track will gain understanding of the principles underlying the processing and analysis of signals, and the applications of signal/image processing methods in basic research and medicine.

Targets

This track aligns most naturally with a combined education of Biomedical Engineering and Electrical & Computer Engineering, which lays a solid foundation in signal processing principles. This track prepares students for careers in medical imaging or smart prosthetics. It also interfaces with many clinical practices including radiology, neurology/neurosurgery, and pathology.

Requirements

In addition to the Biomedical Engineering core courses, students in the BSIP Track must take the following combination of three courses:

- One (1) Required BSIP elective
- Two (2) BSIP Electives (either Required or Additional)

BSIP Electives

Required BSIP Electives (must take at least one of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-431</td>
<td>Introduction to Biomedical Imaging and Image Analysis</td>
<td>12</td>
</tr>
<tr>
<td>42-630</td>
<td>Introduction to Neuroscience for Engineers- Spring</td>
<td>12</td>
</tr>
<tr>
<td>42-631</td>
<td>Neural Data Analysis- Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-632</td>
<td>Neural Signal Processing- Spring</td>
<td>12</td>
</tr>
</tbody>
</table>

Additional BSIP Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-534</td>
<td>Biological Imaging and Fluorescence Spectroscopy- Spring</td>
<td>9</td>
</tr>
<tr>
<td>15-386</td>
<td>Neural Computation- Spring</td>
<td>9</td>
</tr>
<tr>
<td>16-725</td>
<td>(Bio)Medical Image Analysis- Spring</td>
<td>9</td>
</tr>
<tr>
<td>18-491</td>
<td>Fundamentals of Signal Processing*</td>
<td>12</td>
</tr>
<tr>
<td>42-426</td>
<td>Biosensors and BioMEMS- Intermittent</td>
<td>9</td>
</tr>
<tr>
<td>42-437</td>
<td>Biomedical Optical Imaging-Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-447</td>
<td>Rehabilitation Engineering- Fall</td>
<td>9</td>
</tr>
<tr>
<td>42-640/24-658</td>
<td>Image-Based Computational Modeling and Analysis- Spring</td>
<td>12</td>
</tr>
<tr>
<td>42-682</td>
<td>Bioinstrumentation and Measurement</td>
<td>12</td>
</tr>
</tbody>
</table>
Cellular and Molecular Biotechnology (CMBT) Track

Overview
The CMBT track emphasizes fundamentals and applications of biochemistry, biophysics, and cell biology, and processes on the nanometer to micrometer size scale. Students in this track acquire understanding of the molecular and cellular bases of life processes, and build skills in quantitative modeling of live cell-based biotechnologies and in technologies that exploit the unique properties of biomolecules in non-biological settings.

Targets
The CMBT track is ideally suited for the combined education of Biomedical Engineering and Chemical Engineering, which provides a strong core of chemistry and molecular processing principles. The track may also interest students of Mechanical Engineering, Materials Science & Engineering, or Civil & Environmental Engineering who have an interest in molecular biophysics, and cell biology, and processes on the nanometer to micrometer size scale. Students in this track acquire understanding of the molecular and cellular bases of life processes, and build skills in quantitative modeling of live cell-based biotechnologies and in technologies that exploit the unique properties of biomolecules in non-biological settings.

Requirements
In addition to the Biomedical Engineering core courses, students in the CMBT Track must take the following combination of three courses:

- One (1) Required CMBT Elective
- Two (2) CMBT Electives (either Required or Additional)

CMBT Electives
Required CMBT Electives (must take at least one of the following)

- 42-620 Engineering Molecular Cell Biology- Fall 12
- 42-623 Cellular and Molecular Biotechnology- Intermittent 9
- 42-624 Biological Transport and Drug Delivery- Spring 9

Additional CMBT Electives
- 03-320 Cell Biology 9
- 42-630 Bioprocess Design 9
- 42-643 Microfluidics-Intermittent 12
- 42-645/24-655 Cellular Biomechanics- Intermittent 9
- 42-646 Molecular Biomechanics- Intermittent 9
- 42-673 Special Topics: Stem Cell Engineering- Fall, every other year 9
- 42-676 Bio-nanotechnology: Principles and Applications- Fall 9
- 42-x00 BME Research* or 39-500 Honors Research Project* or 42-6XX Clinical Course (Surgery for Engineers/Precision Medicine/ICU Medicine) 9-12

* The 42-x00 research project (42-200/300/400 Sophomore/Junior/Senior Biomedical Engineering Research Project OR 39-500 CIT Honors Research Project) must be on a BME topic that is aligned to the track, supervised or co-supervised by a BME faculty member, and conducted for 9 or more units of credit.

Some Special Topics, newly offered or intermittently offered courses may be acceptable as track electives. Students should consult with their advisors and petition the BME Undergraduate Affairs Committee for permission to include such courses as track electives.

Sample schedules can be found on the BME website. (https://www.cmu.edu/bme/Academics/Undergraduate%20Programs/cmbt_track.html)
Self-Designed Biomedical Engineering (SBME) Track

The SBME track is aimed at helping highly motivated students who have a strong sense of career direction that falls beyond the scope of regular Biomedical Engineering tracks, and allows students to choose courses relevant to the theme from across the University. Students are allowed to design the 'track' portion of the curriculum in consultation with the faculty. Example themes include medical robotics, neural engineering, or computational biomedical engineering.

Requirements

In addition to the Biomedical Engineering core requirements, students must take three elective courses of at least 9 units each. These elective courses must form a coherent theme that is relevant to biomedical engineering. In addition, at least one of the elective courses must be judged by the Biomedical Engineering Undergraduate Affairs Committee to have substantial biological or medical content.

If undergraduate research is part of the SBME track, the research project must be on a BME topic that is aligned to the track, supervised or co-supervised by a BME faculty member, and conducted for 9 or more units of credit.

Petition Procedure

1. Students wishing to pursue a self-designed track should first consult with the Biomedical Engineering Undergraduate Affairs Committee. Contacts for the Committee are Prof. Robert Tilton (https://www.cmu.edu/bme/People/Faculty/profile/tilton.html) (committee chair), and Prof. Conrad Zapanta (https://www.cmu.edu/bme/People/Faculty/profile/czapanta.html) (Biomedical Engineering Associate Head of Undergraduate Affairs).

2. A SBME track proposal must be submitted electronically to Prof. Conrad Zapanta (https://www.cmu.edu/bme/People/Faculty/profile/czapanta.html) at least three weeks prior to Pre-Registration during the spring of the sophomore year. The proposal must include:
   - The three courses of the designed track, including catalog descriptions and when these courses are expected to be taken.
   - A justification of how these courses form a coherent theme relevant to biomedical engineering.
   - Two alternative courses that may substitute for one of the proposed courses, in case the original course is not available.

3. Once approved, the student must sign an agreement listing the theme and the three courses comprising the SBME track. In the event that issues beyond the student’s control, such as course scheduling or cancellation, prevent the student from completing the approved course plan, the student may petition the Biomedical Engineering Undergraduate Affairs Committee to substitute a course with another course that fits the approved theme, OR complete one of the regular tracks (all classes).

Minor in Biomedical Engineering

Professor Conrad M. Zapanta, Associate Department Head of Undergraduate Education
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www.bme.cmu.edu (http://www.bme.cmu.edu/)

The minor program is designed for engineering students who desire exposure to biomedical engineering but may not have the time to pursue the Biomedical Engineering additional major. The program is also open to students of all colleges and is popular among science majors. In conjunction with other relevant courses, the program may provide a sufficient background for jobs or graduate studies in biomedical engineering. Students interested in a medical career may also find this program helpful.

The Biomedical Engineering minor curriculum is comprised of three core courses and three electives. Students pursuing the minor may contact the BME Associate Head for Undergraduate Education (https://www.cmu.edu/bme/People/Faculty/profile/czapanta.html) (http://www.bme.cmu.edu/people/staff.html) or the Biomedical Engineering Undergraduate Program Coordinator (https://www.cmu.edu/bme/People/Administration).
CHOSET, HOWE, Professor, Robotics Institute, Biomedical Engineering, and Electrical & Computer Engineering - Ph.D., California Institute of Technology , 1996;

COHEN-KARNI, TZAHI (ITZHAQ), Associate Professor of Biomedical Engineering and Materials Science & Engineering - Ph.D., Harvard University, 2011;

COOK, KEITH, Professor and Associate Department Head of Graduate Studies of Biomedical Engineering - Ph.D., Northwestern University, 2000;

DAHL, KRIS N., Professor of Chemical Engineering, Biomedical Engineering, and Materials Science & Engineering - Ph.D., University of Pennsylvania, 2004;

DOMACH, MICHAEL M., Professor of Chemical Engineering and Biomedical Engineering - Ph.D., Cornell University, 1983;

FEDDER, GARY K., Howard M. Wilkoff Professor, Institute for Complex Engineering Systems, Biomedical Engineering, Electrical & Computer Engineering, Robotics Institute - Ph.D., University of California, Berkeley, 1994;

FEINBERG, ADAM W., Arthur Hamerschlag Career Development Professor; Professor of Biomedical Engineering and Materials Science & Engineering - Ph.D., University of Florida, 2004;

GALLETTI, JOHN, Systems Scientist, Robotics Institute and Assistant Professor of Biomedical Engineering - Ph.D., Carnegie Mellon University, 2007;

GEYER, HARMUT, Associate Professor, Robotics Institute and Biomedical Engineering – Ph.D., Friedrich-Schiller-University of Jena, Germany, 2005;

GITTIS, ARYN, Associate Professor, Biological Sciences, and Biomedical Engineering – Ph.D., University of California, San Diego, 2008;

GROVER, PULKIT, Associate Professor, Electrical & Computer Engineering, Center for Neural Basis of Cognition, and Biomedical Engineering - Ph.D., University of California, Berkeley, 2010;

HALILAJ, ENI, Assistant Professor, Mechanical Engineering and Biomedical Engineering - Ph.D., Brown University, 2015;

HE, BIN, Trustee Professor and Department Head, Biomedical Engineering - Ph.D., Tokyo Institute of Technology, 1988;

KAINERSTORFER, JANA M., Assistant Professor of Biomedical Engineering - Ph.D., University of Vienna, 2010;

KASS, ROBERT, Maurice Falk Professor, Statistics, Department of Machine Learning, Center for the Neural Basis of Cognition, and Biomedical Engineering Interim co-Director, Center for the Neural Basis of Cognition – Ph.D., University of Chicago, 1989;

KELLY, SHAWN, Adjunct Associate Professor of Biomedical Engineering - Ph.D., Massachusetts Institute of Technology, 2003;

KUHLMAN, SANDRA, Associate Professor, Biological Sciences, and Biomedical Engineering – Ph.D., University of Kentucky, 2001;

LEDUC, PHILIP R., Professor of Mechanical Engineering, Biomedical Engineering, and Biological Sciences – Ph.D., Johns Hopkins University, 1999;

LOESCHE, MATHIAS, Professor of Physics and Biomedical Engineering - Ph.D., Technical University of Munich, 1986;

MAJIDI, CARMEL, Associate Professor of Mechanical Engineering and Biomedical Engineering - Ph.D., University of California, Berkeley; Carnegie Mellon, 2007–;

MINDEN, JONATHAN S., Professor of Biological Sciences and Biomedical Engineering – Ph.D., Albert Einstein College of Medicine, 1995;

MITCHELL, TOM M., E. Fredkin University Professor, Computer Science, Robotics, Language Technologies, and Biomedical Engineering – Ph.D., Stanford University, 1979;

MOURA, JOSE M. F., University Professor of Electrical & Computer Engineering and Biomedical Engineering - Ph.D., Massachusetts Institute of Technology, 1975;

MURPHY, ROBERT F., Ray and Stephanie Lane Professor of Computational Biology and Professor of Biological Sciences, Biomedical Engineering, and Machine Learning – Ph.D., California Institute of Technology, 1980;

OZDOGANLAR, BURAK, Ver Planck Professor, Mechanical Engineering and Biomedical Engineering - Ph.D., University of Michigan, 1999;

PANAT, RAHUL, Associate Professor, Mechanical Engineering, Civil & Environmental Engineering, Materials Science & Engineering, and Biomedical Engineering – Ph.D., University of Illinois at Urbana-Champaign, 2004;

RABIN, YOED, Professor of Mechanical Engineering and Biomedical Engineering – D.Sc., Technion - Israel Institute of Technology, 1994;

REN, XI (CHARLIE), Assistant Professor of Biomedical Engineering – Ph.D., Peking University, 2011;

RIVIERE, CAMERON N., Associate Research Professor, Robotics Institute and Biomedical Engineering – Ph.D., Johns Hopkins University, 1995;

RUSSELL, ALAN J., Highmark Distinguished Career Professor, Institute of Complex Engineering Systems and Biomedical Engineering – Ph.D., University of London, 1987;

SCHNEIDER, JAMES W., Professor of Chemical Engineering and Biomedical Engineering – Ph.D., University of Minnesota, 1998;

SHIMADA, KENJI, Theodore Ahrens Professor, Mechanical Engineering and Biomedical Engineering – Ph.D., Massachusetts Institute of Technology, 1993;

SHINN-CUNNINGHAM, BARBARA, Director, Carnegie Mellon Neuroscience Institute Professor, Center for the Neural Basis of Cognition, Biomedical Engineering, Psychology, and Electrical & Computer Engineering – Ph.D., Massachusetts Institute of Technology, 1994;

SIMKO (PALCESKO), RACHELLE, Special Faculty - Researcher – Ph.D., Duquesne University, 2011;

SMITH, MATTHEW, Associate Professor, Biomedical Engineering and Center for the Neural Basis of Cognition – Ph.D., New York University, 2003;

SYDLIK, STEFANIE, Assistant Professor of Chemistry and Biomedical Engineering – Ph.D., Massachusetts Institute of Technology, 2012;

TAYLOR, REBECCA, Ph.D. - Assistant Professor of Mechanical Engineering and Biomedical Engineering, Stanford University, 2013;

TILTON, ROBERT D., Chevron Professor; Professor, Biomedical Engineering and Chemical Engineering – Ph.D., Stanford University, 1991;

TRUMBLE, DENNIS, Associate Research Professor, Biomedical Engineering and Center for the Neural Basis of Cognition – Ph.D., Carnegie Mellon University, 2010;

VERSTYNEN, TIMOTHY, Associate Professor, Psychology, Center for the Neural Basis of Cognition and Biomedical Engineering - Ph.D., University of California, Berkeley, 2006;

WANG, YU-LI, Mehrabian Professor of Biomedical Engineering – Ph.D., Harvard University, 1980;

WASHBURN, NEWELL R., Associate Professor of Biomedical Engineering, Chemistry, and Materials Science & Engineering - Ph.D., University of California, Berkeley, 1998;

WAYNE, ELIZABETH, Assistant Professor, Biomedical Engineering and Chemical Engineering – Ph.D., Cornell University, 2015;

WEBSTER-WOOD, VICTORIA, Assistant Professor, Mechanical Engineering and Biomedical Engineering – Ph.D., Case Western Reserve University, 2017;

WHITEHEAD, KATHRYN A, Associate Professor of Chemical and Biomedical Engineering – Ph.D., University of California, Santa Barbara, 2007;

YTTRI, ERIC, Assistant Professor, Biological Sciences, Center for the Neural Basis of Cognition, Biomedical Engineering – Ph.D., Washington University in St Louis, 2011;

YU, BYRON, Professor of Biomedical Engineering and Electrical & Computer Engineering – Ph.D., Stanford University, 2007;

ZAPANTA, CONRAD M., Teaching Professor and Associate Head of Undergraduate Education of Biomedical Engineering – Ph.D., The Pennsylvania State University, 1997;

ZHANG, YONGJIE JESSICA, Associate Professor of Mechanical Engineering and Biomedical Engineering – Ph.D., University of Texas at Austin, 2005;

ZHENG, SIYANG, Associate Professor, Biomedical Engineering and Electrical and Computer Engineering – Ph.D., California Institute of Technology, 2007;