Plan of Study for the Bioengineering Track  
of the Engineering Sciences SB Concentration  
Effective for Students Declaring the Concentration after July 1, 2018

NAME: ___________________________  CLASS: ____________________

EMAIL: ___________________________  DATE: ____________________

This Plan of Study Form is for a (Circle One):  DECLARATION  REVISION

The S.B. Program in Engineering Sciences must contain at least 20 courses: 4 courses in mathematics, 4 courses in basic sciences, and 12 courses in engineering topics. This Plan of Study is not final until this form has been signed, ensuring that the proposed plan meets the ABET distribution requirements.

<table>
<thead>
<tr>
<th>REQUIRED COURSES</th>
<th>Math</th>
<th>Science</th>
<th>Engr. Topics</th>
<th>Semester (FA/SP Year)</th>
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</thead>
<tbody>
<tr>
<td><strong>Mathematics</strong> (2-4 courses)</td>
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<tr>
<td>Begin according to placement:</td>
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<tr>
<td>Math 1a – Introduction to Calculus I</td>
<td>1.0</td>
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<tr>
<td>Math 1b – Calculus, Series, and Differential Equations</td>
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<tr>
<td>AM 21a – Mathematical Methods in the Sciences I (or Mathematics 21a or 23a)</td>
<td>1.0</td>
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<tr>
<td>AM 21b – Mathematical Methods in the Sciences II (or Mathematics 21b or 23b)</td>
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<tr>
<td><strong>Probability &amp; Statistics</strong> (1 course, if starting in Math 1b or higher)</td>
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<tr>
<td>Select one (ES150 preferred for Electrical Subtrack):</td>
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<tr>
<td>AM 101 – Statistical Inference for Scientists &amp; Engineers</td>
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<tr>
<td>Statistics 110 – Introduction to Probability</td>
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<tr>
<td><strong>Applied Mathematics</strong> (1 course, if starting in Math 21a or equivalent)</td>
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<td>Select one:</td>
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<tr>
<td>AM 104 – Series Expansions &amp; Complex Analysis</td>
<td>(1.0)</td>
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<tr>
<td>AM 105 – Ordinary &amp; Partial Differential Equations</td>
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<td>AM 106 – Applied Algebra</td>
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<td>AM 107 – Graph Theory &amp; Combinatorics</td>
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<tr>
<td><strong>Physics</strong> (2 courses)</td>
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<tr>
<td>AP 50a – Physics as a Foundation for Sci. &amp; Eng. Part I (or PS 12a or Physics 15a or 16)</td>
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<tr>
<td>AP 50b – Physics as a Foundation for Sci. &amp; Eng. Part II (or PS 12b or Physics 15b)</td>
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<tr>
<td><strong>Computer Science</strong> (1 course)</td>
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<td>Select one:</td>
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<tr>
<td>CS 50 – Introduction to Computer Science I</td>
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<td>CS 51 – Introduction to Computer Science II</td>
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<td>CS 61 – Systems Programming &amp; Machine Organization</td>
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<tr>
<td>REQUIRED COURSES</td>
<td>Math</td>
<td>Science</td>
<td>Engr. Topics</td>
<td>Semester (FA/SP Year)</td>
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<tr>
<td><strong>Chemistry/Life Sciences</strong> (2 courses)</td>
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<tr>
<td>Select two (either Chemistry 17 or 20 is required for the Chemical &amp; Materials Subtrack):</td>
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<tr>
<td>LS 1a – Intro to the Life Sciences</td>
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<td>(or LPS A – Foundational Chemistry &amp; Biology)</td>
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<td>LS 1b – Genetics, Genomics, and Evolution</td>
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<td>PS 10 – Chemistry: A Microscopic Perspective</td>
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<td>PS 11 – Foundations &amp; Frontiers in Modern Chemistry</td>
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<td>(or PS 1 – Chemical Bonding, Energy, &amp; Reactivity)</td>
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<tr>
<td>CHEM 17 – Principles of Organic Chemistry</td>
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<td>(or CHEM 20 – Organic Chemistry)</td>
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<td><strong>Sophomore Forum</strong></td>
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<td>Required, non-credit.</td>
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<tr>
<td><strong>Bioengineering Core: Physiology &amp; Modeling</strong> (2 courses)</td>
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<tr>
<td>ES 53 – Quantitative Physiology as a Basis for Bioengineering</td>
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<tr>
<td>BE 110 – Physiological Systems Analysis</td>
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<tr>
<td><strong>Subtrack-specific Courses</strong> (4 courses) Select one Subtrack:</td>
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<tr>
<td>• Mechanical Subtrack</td>
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<tr>
<td>o ES 120 – Intro to the Mechanics of Solids</td>
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<td>o ES 123 – Intro to Fluid Mechanics</td>
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<td>o ES 181 – Engineering Thermodynamics</td>
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<td>o BE 191 – Intro to Biomaterials (preferred)</td>
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<td>(or ES 190 – Intro to Materials Science &amp; Eng.)</td>
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<td>• Electrical Subtrack</td>
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<tr>
<td>o ES 54 – Electronics for Engineers (or ES 153 (or both of ES 152 and CS 141))</td>
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<tr>
<td>o Signals and systems courses (select two): BE 128 – Biomedical Imaging and Systems, BE 130 – Neural Control of Movement, ES 157 – Biological Signal Processing</td>
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<td>o Another approved EE course (if ES 54/153 is taken) (see last page for list of EE electives)</td>
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<td>• Chemical &amp; Materials Subtrack</td>
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<tr>
<td>o BE 121 – Cellular Engineering</td>
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<td>(or BE 125 – Tissue Engineering)</td>
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<td>o ES 123 – Intro to Fluid Mechanics</td>
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<td>o ES 181 – Engineering Thermodynamics</td>
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<td>(or ES 112 – Thermodynamics by Case Study)</td>
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<td>o BE 191 – Intro to Biomaterials (preferred)</td>
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<td>(or ES 190 – Intro to Materials Science &amp; Eng.)</td>
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<tr>
<td><strong>Approved Engineering Electives</strong>* (3 courses)</td>
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<tr>
<td>Select three courses, at least two at the 100- or 200-level, from the list on pages 4-5.</td>
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</tbody>
</table>
REQUIRED COURSES
(Circle or fill-in for courses planned in each category.)

<table>
<thead>
<tr>
<th>Math</th>
<th>Science</th>
<th>Engr. Topics</th>
<th>Semester (FA/SP Year)</th>
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<tbody>
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<td>2.</td>
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</table>

Engineering Design (2 courses)

<table>
<thead>
<tr>
<th>Math</th>
<th>Science</th>
<th>Engr. Topics</th>
<th>Semester (FA/SP Year)</th>
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<tbody>
<tr>
<td></td>
<td>ES 96</td>
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<td>ES 227</td>
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<td>ES 100hf</td>
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</tbody>
</table>

TOTALS /4 /4 /12

* Engineering Sciences 6, 50, 51, and 53: No more than two of these courses may count towards concentration credit. Engineering Sciences 6 and 50 can only count as an engineering elective when taken during the freshman or sophomore year.

ES 91r may be included as an Engineering Elective in a Revised Plan of Study following the approval of a written petition and a signed certification that the project meets the ABET definition of an engineering topic.

For courses that are co-listed in another department, students must enroll in the Engineering Sciences offering.

Required Signatures:

_________________________________________________________   
Student                                           Date

_________________________________________________________   
Assistant/Director of Undergraduate Studies         Date

This plan does / does not meet the ABET distribution requirements.

_________________________________________________________   
Associate Dean for Education                     Date
Pre-approved Courses for the SB in Engineering Sciences

Engineering Courses
These courses fulfill the requirement for ABET engineering topics and are sorted by depth area. For courses that are co-listed in another department, students must enroll in the Engineering Sciences offering.

Biological and Biomedical
- ES 53 – Quantitative Physiology as a Basis for Bioengineering
- BE 110 – Physiological Systems Analysis
- BE 121 – Cellular Engineering
- BE 125 – Tissue Engineering
- BE 128 – Intro. to Biomedical Imaging
- BE 130 – Neural Control of Movement
- BE 160 – Chemical Kinetics
- BE 191 – Intro to Biomaterials
- ES 211 – Microphysiological Systems
- ES 221 – Drug Delivery
- ES 227 – Medical Device Design
- ES 228 – Biologically-Inspired Materials

Computer
- CS 51 – Intro to Computer Science 2
- CS 61 – System Programming & Machine Organization
- CS 141 – Computing Hardware
- CS 143 – Computer Networks
- CS 146 – Computer Architecture
- CS 148 – Design of VLSI Circuits & Systems
- CS 175 – Computer Graphics

Electrical
- ES 50 – Intro to Electrical Engineering
- ES 54 – Electronics for Engineers
- ES 151 – Applied Electromagnetism
- ES 152 – Circuits, Devices, and Transduction
- ES 153 – Laboratory Electronics
- ES 154 – Electronic Devices & Circuits
- ES 155 – Systems and Control
- ES 156 – Signals and Communications
- ES 157 – Biological Signal Processing
- ES 158 – Feedback Systems: Analysis and Design
- ES 159 – Intro to Robotics
- ES 173 – Electronic and Photonic Devices
- ES 175 – Photovoltaic Devices
- ES 177 – Microfabrication Laboratory
- CS 141 – Computing Hardware
- CS 146 – Computer Architecture
- CS 148 – Design of VLSI Circuits & Systems

Engineering Physics and Chemistry
- ES 135 – Phys & Chem: In the Context of Energy & Climate
- ES 173 – Introduction to Electronic and Photonic Devices
- ES 181 – Engineering Thermodynamics
- ES 190 – Intro to Materials Science & Engineering
- ESE 112 – Thermodynamics by Case Study
**Environmental**
- ESE 6 – Intro to Environmental Science & Engineering
- ESE 109 – Earth Resources and the Environment
- ESE 112 – Thermodynamics by Case Study
- ES 123 – Intro to Fluid Mechanics & Transport Processes
- ESE 130 – Biogeochemistry of Carbon Dioxide and Methane
- ESE 131 – Introduction to Physical Oceanography and Climate
- ESE 132 – Introduction to Meteorology and Climate
- ESE 133 – Atmospheric Chemistry
- ESE 135 – Phys & Chem: In the Context of Energy & Climate at the Global & Molec. Level
- ESE 160 – Space Science and Engineering: Theory and Applications
- ESE 161 – Applied Environmental Toxicology
- ESE 162 – Hydrology & Environmental Geomechanics
- ESE 163 – Pollution Control in Aquatic Ecosystems
- ESE 164 – Environmental Chemistry
- ESE 165 – Water Engineering
- ESE 166 – State-of-the-art Instrumentation in Environmental Sciences
- ESE 169 – Seminar on Global Pollution Issues

**Mechanics and Materials**
- ES 51 – Computer Aided Machine Design
- ES 120 – Intro to the Mechanics of Solids
- ES 123 – Intro to Fluid Mechanics & Transport Processes
- ES 125 – Mechanical Systems
- ES 128 - Computational Solid & Structural Mechanics
- ES 181 – Engineering Thermodynamics
- ES 183 – Introduction to Heat Transfer
- ES 190 – Intro to Materials Science & Engineering

**General Engineering Electives - Cannot be used for Depth or Breadth Areas**
- ES 111 – Intro to Scientific Computing
- ES 115 – Mathematical Modeling
- ES 121 – Intro to Optimization: Models & Methods