Plan of Study for the Engineering Sciences SB Concentration  
*Bioengineering Track*  
Effective for Students Declaring the Concentration after January 1, 2015

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 half courses: 4 half-courses in mathematics, 4 half-courses in basic sciences, and 12 half-courses in engineering topics. This Plan of Study will not be considered final until this form has been signed. The signature of this form ensures 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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Mathematics (2-4 half-courses)</strong></td>
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<tr>
<td>Begin according to placement</td>
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<tr>
<td>Math 1a – Intro to Calculus I</td>
<td>1.0</td>
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<tr>
<td>Math 1b – Intro to Calculus II</td>
<td>1.0</td>
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<tr>
<td>AM 21a – Mathematical Methods in the Sciences I</td>
<td>1.0</td>
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<td>(or Math 21a or 23a)</td>
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<tr>
<td>AM 21b – Mathematical Methods in the Sciences II</td>
<td>1.0</td>
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<td>(or Math 21b or 23b)</td>
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<tr>
<td><strong>Probability &amp; Statistics (1 half-course if you started in Math 1b or later; ES150 preferred for electrical focus)</strong></td>
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<tr>
<td>CIRCLE ONE</td>
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<tr>
<td>AM 101 – Statistical Inference for Scientists &amp; Engineers</td>
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<tr>
<td>ES 150 – Intro Probability w/ Engineering Applications</td>
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<tr>
<td>Statistics 110 – Intro to Probability</td>
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<tr>
<td><strong>Applied Mathematics (1 half-course if you started in AM/Math 21a)</strong></td>
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<tr>
<td>CIRCLE ONE</td>
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<tr>
<td>AM 104</td>
<td>1.0</td>
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<tr>
<td>AM 105</td>
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<td>AM 106</td>
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<td>AM 107</td>
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<tr>
<td><strong>Physics (2 half-courses)</strong></td>
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<tr>
<td>AP 50a – Physics as a Foundation for Sci. &amp; Eng. I</td>
<td>1.0</td>
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<td>(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. II</td>
<td>1.0</td>
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<tr>
<td>(or PS 12b or Physics 15b)</td>
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### REQUIRED COURSES
(Circle or fill-in information for each course you plan to take in each category.)

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#### Chemistry/Life Sciences (2 half-courses)
CIRCLE TWO
LS 1a (or LPSA)
PS 1
PS 10
PS 11
Chem 17
Chem 20
*(Organic chemistry, either Chem 17 or 20, required for Chem & Materials specialization)*

#### Sophomore Forum
*Required, non-credit.*

#### Computer Science (1 half-course)
CIRCLE ONE
CS 50 – Introduction to Computer Science I
CS 51 – Introduction to Computer Science II
CS 61 – System Programming & Machine Organization

#### Bioengineering Core: Physiology and modeling
*(2 half-courses)*
ES 53
BE 110 (formerly ES 145)

#### Specialization-specific Courses* (4 half-courses)
Select one out of the three areas of specialization
- **Mechanical**
  - ES 120
  - ES 123
  - ES 181
  - BE 191 (preferred) or ES 190
- **Electrical**
  - BE 130 (formerly ES 149)
  - ES 52
  - ES 154
  - ES 156
- **Chemical & Materials**
  - BE 121 (formerly ES 122) or BE 125 (formerly ES 130)
  - ES 123
  - ES 181
  - BE 191 (preferred) or ES 190

#### Approved Engineering Electives* (3 half-courses)
*At least two at 100 or 200 level, see list on pages 5-6*
1.
2.
3.
**REQUIRED COURSES**  
(Circle or fill-in information for each course you plan to take in each category.)

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**Engineering Design (2 half-courses)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Math</th>
<th>Science</th>
<th>Engr. Topics</th>
<th>Semester (FA/SP Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Sciences 96</td>
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<td>1.0</td>
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</tr>
<tr>
<td>Engineering Sciences 100hf</td>
<td></td>
<td>1.0</td>
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</table>

**TOTALS**

<table>
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<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>12</td>
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</tbody>
</table>

* One of ES 1, 6, 50, or 51 may be counted as an Engineering Elective if taken during the Freshman or Sophomore year. ES 91r and ES 95r 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 Signature

Date

Assistant Director for Undergraduate Studies (BE)

Date

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

Assistant Dean for Academic Programs

Date
Plan of Study for the Engineering Sciences SB Concentration

Bioengineering Track

Effective for Students Declaring the Concentration after January 1, 2015

INSTRUCTIONS:

The Engineering Sciences SB program is an interdisciplinary concentration that allows students to pursue coursework around one or two central themes related to engineering practice or current topics in engineering research. While the degree requirements are sufficiently flexible to accommodate student interests that span the traditional engineering fields, students who wish to concentrate in Engineering Sciences must present an intellectually coherent plan of study and describe how the selected courses will form this program.

Students intending to focus their degree program around the Bio/Biomedical Engineering depth area have the option to follow a set of pre-approved guidelines that form a Bioengineering (BioE) Track within the flexible structure of the Engineering Sciences SB requirements. These intellectually coherent guidelines have been vetted by the faculty, do not require further written justification, and encourage students to focus on one specialization area (Mechanical, Electrical, or Chemical & Materials) to ensure adequate depth of knowledge. Students should work in close consultation with the assistant director for undergraduate studies (ADUS) or the director for undergraduate studies (DUS) in bioengineering to review the course program before declaring.

Students declaring the Engineering Sciences SB concentration must file an approved Plan of Study with the Office of Student Affairs at the time of declaration. Students must keep their Plan of Study up-to-date by filing an approved Revised Plan of Study during any semester that changes to the course program will be made. Students should discuss their proposed revisions with an ADUS or the DUS. Course substitutions are a change in the Plan of Study and WILL NOT BE APPROVED without preapproval and a revision to the Plan of Study Form.

For an initial declaration of the Engineering Sciences SB concentration, students may not include any courses that would require a petition in their Plan of Study. This includes ES 91r, ES 95r, and courses offered at MIT. However, following discussion with faculty advisers and an ADUS, other relevant and/or advanced courses may be included in a Revised Plan of Study through an approved petition. This petition must present a coherent and persuasive written argument for the intellectual merit of the proposed substitution.

To complete a Plan of Study form, fill-in your name, date, class year, email address, and circle if this form is for an initial Declaration of Concentration or for a Revision to an existing plan. Review the requirements for each section, and circle or fill-in the course number for the appropriate number of required courses that you have taken or are planning to take. Once all of the proposed courses are included on the form, sum the total number of half-courses for each column to ensure that the proposed degree program meets the requirements of 4 half-courses on Mathematics, 4 half-courses on the Basic Sciences, and 12 half-courses on Engineering Topics.
Pre-approved Courses for Engineering Electives
(Fulfills requirement for ABET engineering topics)

Bio/Biomedical
- ES 53 – Quantitative Physiology as a Basis for Bioengineering
- BE 110 – Physiological Systems Analysis
- BE 121 – Cellular Engineering
- BE 191 – Biomaterials
- BE 125 – Tissue Engineering
- BE 130 – Neural Control of Movement
- BE 160 – Chemical Kinetics and Reactor Design
- ES 221 – Drug Delivery
- ES 228 – Biomaterials
- ES 227 – Medical Device Design

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 52 – The Joy of Electronics
- ES 151 – Applied Electromagnetism
- ES 154 – Electronic Devices & Circuits
- ES 156 – Signals & Systems
- ES 159 – Intro to Robotics
- CS 141 – Computing Hardware
- CS 148 – Design of VLSI Circuits & Systems
- ES 153 – Laboratory Electronics

Engineering Physics and Chemistry
- ES 181 – Engineering Thermodynamics
- ES 180 – Intro to Materials Science & Engineering

Environmental
- ES 6 – Environmental Science & Technology
- ES 103 – Spatial Analysis of Environmental & Social Systems
- ES 123 – Intro to Fluid Mechanics & Transport Processes
- ES 133 – Atmospheric Chemistry
- ES 135 – Phys & Chem: In the Context of Energy & Climate at the Global & Molecular Level
- ES 162 – Hydrology & Environmental Geomechanics
- ES 164 – Environmental Chemistry
- ES 165 – Water Engineering

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 190 – Intro to Materials Science & Engineering
General Engineering Electives

- ES 111 – Intro to Scientific Computing
- ES 115 – Mathematical Modeling
- ES 121 – Intro to Optimization: Models & Methods