Plan of Study for the Environmental Science & Engineering Track
of the Engineering Sciences SB Concentration
Effective for Students Declaring the Concentration after July 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>&lt;br&gt;Begin according to placement&lt;br&gt;Math 1a – Introduction to Calculus I</td>
<td></td>
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<tr>
<td>Math 1b – Calculus, Series, and Differential Equations</td>
<td>1.0</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>
<td>1.0</td>
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<tr>
<td><strong>Probability &amp; Statistics (1 half-course if you started in Math 1b or 21a)</strong>&lt;br&gt;AM 101 – Statistical Inference for Scientists &amp; Engineers&lt;br&gt;ES 150 – Intro to Probability with Engineering Applications&lt;br&gt;Statistics 110 – Introduction to Probability</td>
<td>1.0</td>
<td></td>
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<tr>
<td><strong>Applied Mathematics (1 half-course if you started in Math 21a)</strong>&lt;br&gt;Select from list on Page 5&lt;br&gt;1.</td>
<td>1.0</td>
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<tr>
<td><strong>Physics (2 half-courses)</strong>&lt;br&gt;AP 50a – Physics as a Foundation for Sci. &amp; Eng. I (or Physical Sciences 12a or Physics 15a or 16)</td>
<td>1.0</td>
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<tr>
<td>AP 50b – Physics as a Foundation for Sci. &amp; Eng. II (or Physical Sciences 12b or Physics 15b)</td>
<td>1.0</td>
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<tr>
<td><strong>Chemistry/Life Sciences (2 half-courses)</strong>&lt;br&gt;Select from list on page 5.&lt;br&gt;1.</td>
<td>1.0</td>
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<td>2.</td>
<td>1.0</td>
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<tr>
<td><strong>Sophomore Forum</strong>&lt;br&gt;Required, non-credit.</td>
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</tbody>
</table>
## REQUIRED COURSES
(Circle or fill-in the course number and distribution % for each course you plan to take in each category.)

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

### Computer Science (1 half-course)
- CS 50 – Introduction to Computer Science I
- CS 51 – Introduction to Computer Science II
- CS 60 – System Programming & Machine Organization

| 1.0       |      | _____ |   |

### Environmental Science & Engineering Core
(5 half-courses)
- Engineering Sciences 6

| 1.0       |      | _____ |   |

**Four from:**

| 1.0       | 1.0  | _____ |   |
| 1.0       | 1.0  | _____ |   |
| 1.0       | 1.0  | _____ |   |
| 1.0       | 1.0  | _____ |   |

### Engineering Breadth (3 half-courses)
Select one upper-level (>100) course from each of these 3 Depth Areas, see lists on Page 5-6. (Note: ES52 may be used for the Electrical requirement.)

#### Area: Mechanics & Materials
- Course:

| 1.0       |      | _____ |   |

#### Area: Engineering Physics & Chemistry
- Course:

| 1.0       |      | _____ |   |

#### Area: Electrical
- Course:

| 1.0       |      | _____ |   |

### Approved Engineering Electives (1 half-courses)
Select at least 1 additional course on engineering topics*

1. 

| 1.0       |      | _____ |   |

### Engineering Design (2 half-courses)
- Engineering Sciences 96
- Engineering Sciences 100hf

| 1.0       |      | _____ |   |
| 1.0       |      | _____ |   |

### TOTALS

| /4 | /4 | /12 |

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* Only one from Engineering Sciences 50, 51, and 53 may count toward concentration credit; Engineering Sciences 50 and 53 can only count as an engineering elective when 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.
Required Signatures:

__________________________________________________________________________  __________
Student  Date

__________________________________________________________________________  __________
Assistant/Director for Undergraduate Studies  Date

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

__________________________________________________________________________  __________
Assistant Dean for Education  Date
Plan of Study for the Environmental Science & Engineering Track
of the Engineering Sciences SB Concentration

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. The degree requirements are sufficiently flexible to accommodate student interests that span the traditional engineering fields. As such, 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 should work in close consultation with an Assistant Director for Undergraduate Studies (ADUS) or the Director for Undergraduate Studies (DUS) to construct a degree program and must include the required written justification as a part of their Plan of Study.

Students intending to focus their degree program around the Environmental Science & Engineering (ESE) depth area have the option to follow a set of pre-approved guidelines that form an ESE Track within the flexible structure of the Engineering Sciences SB requirements. These intellectually coherent guidelines have been vetted by the faculty to allow students to structure a rigorous engineering program with a strong emphasis in ESE without further written justification.

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 the SB in Engineering Sciences

**Applied Mathematics**
AM 104 – Series Expansions & Complex Analysis
AM 105 – Ordinary & Partial Differential Equations
AM 106 – Applied Algebra
AM 107 – Graph Theory & Combinatorics

**Chemistry**
LS 1a - Intro to the Life Sciences: Chemistry, Molecular Biology, & Cell Biology
  or LPS A – Foundational Chemistry & Biology
PS 10 - Chemistry: A Microscopic Perspective on Molecules, Materials, & Life
PS 11 - Foundations & Frontiers of Modern Chem: A Molecular & Global Perspective
  or PS 1 - Chemical Bonding, Energy, & Reactivity: An Intro to the Physical Sciences

**Engineering Courses**
Sorted by Depth Area and fulfills requirement for ABET engineering topics. For courses that are co-listed in another department, students must enroll in the Engineering Sciences offering.

**Environmental**
ES 6 – Environmental Science & Technology
ES 103 – Spatial Analysis of Environmental & Social Systems
ES 109 – Earth Resources and the Environment
ES 112 – Thermodynamics by Case Study
ES 123 – Intro to Fluid Mechanics & Transport Processes
ES 131 – Introduction to Physical Oceanography and Climate
ES 132 – Introduction to Meteorology and Climate
ES 133 – Atmospheric Chemistry
ES 135 – Phys & Chem: In the Context of Energy & Climate at the Global & Molecular Level
ES 160 – Space Science: Theory and Applications
ES 161 – Applied Environmental Toxicology
ES 162 – Hydrology & Environmental Geomechanics
ES 163 – Pollution Control in Aquatic Ecosystems
ES 164 – Environmental Chemistry
ES 165 – Water Engineering
ES 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
Engineering Physics and Chemistry
ES 135 – Phys & Chem: In the Context of Energy & Climate at the Global & Molecular Level
ES 173 – Introduction to Electronic and Photonic Devices
ES 181 – Engineering Thermodynamics
ES 190 – Intro to Materials Science & Engineering

Electrical
ES 50 – Intro to Electrical Engineering
ES 52 – Joy of Electronics
ES 151 – Applied Electromagnetism
ES 153 – Laboratory Electronics
ES 154 – Electronic Devices & Circuits
ES 155 – Biological Signal Processing
ES 156 – Signals & Systems
ES 158 – Feedback Systems: Analysis and Design
ES 159 – Intro to Robotics
ES 173 – Introduction to 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

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 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

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

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