Plan of Study for the Environmental Science & Engineering AB Concentration
Effective for Students Declaring the Concentration after August 1, 2024

NAME: ___________________ CLASS: _____ EMAIL: ___________________________ DATE: ____________

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

In a few sentences, describe your main interest area within Environmental Science and Engineering:

Please list your selected concentration courses in the schedule below:

<table>
<thead>
<tr>
<th>1st Fall</th>
<th>1st Spring</th>
<th>2nd Fall</th>
<th>2nd Spring</th>
<th>3rd Fall</th>
<th>3rd Spring</th>
<th>4th Fall</th>
<th>4th Spring</th>
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</table>

REQUIRED COURSES
Mathematics (2-5 courses)

Begin according to placement:
Math 1a – Introduction to Calculus I (or Math Ma & Mb)
Math 1b – Calculus, Series, and Differential Equations
Math 21a – Multivariable Calculus (or Math 22a, 25a)
Math 21b – Linear Algebra and Differential Equations (or Math 22b, 25b)
*Note that Math 18/19 series do not count your concentration credit.

Physics (2 courses)

PS 12a – Electromagnetism and Quantum Physics (or AP 50a or Physics 15a or 16)
PS 12b – Mechanics and Statistical Physics (or AP 50b or Physics 15b)

Chemistry / Basic Sciences (2 courses)

PS 11 – Foundations and Frontiers of Modern Chemistry (Required)

Take one from the following or petition for more advanced courses:
LPS A – Foundational Chemistry and Biology (or LS 1a)
CHEM 10 – Quantum and Statistical Foundations of Chemistry
CHEM 17 – Principles of Organic Chemistry (or CHEM 20)
**REQUIRED COURSES**

<table>
<thead>
<tr>
<th>Gateway Course (1 course)</th>
<th>Selected Courses</th>
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<tbody>
<tr>
<td>ESE 6 – Intro to Environmental Science &amp; Engineering <em>(strongly recommended)</em></td>
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<tr>
<td>(With permission of the DUS, may be substituted by an advanced ESE course or ESE 50)</td>
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</table>

**Thematic Plan Electives (5 courses):**

*Select a thematic plan and five courses*. **Courses in Bold** must be included. If not choosing a thematic plan, you must choose 7 courses from the approved electives list and include at least four courses from ESE (including graduate-level ES courses taught by ESE faculty).

- **Climate Change:**
  - ESE 101, 129, 131, 133, 162, 168; ES 260, 268; OEB 120

- **Energy:**
  - ESE 109; ES 112 or 181, 173, 183, 190, 231, 248; PHY 129

- **Ecosystem Science and Management:**
  - ESE 115, 133, 161, 162, 163, 164, 169; ES 123; OEB 55

- **Environmental Data Analytics and Modeling:**
  - ESE 101, 102, 168, 169; ES 266; CS 109; AM 101, 115, 120; STAT 110 or 111; ES 123

- **Sustainable Design:**
  - ESE 161, 163, 164, 166; ES 50, 51, 183, 192, 291; SCI 6121 & 6122

**Approved Electives** (2 courses; or 7 courses if not choosing a Thematic Plan)

*Select two (or 7) from the options below*:  
- Data analytics, statistics, and scientific computing †: AM10, 101, 120; CS 32, 50, 109a, 109b; SCI 5; Stat 110  
- Engineering Sciences: ES 91r (one term), 96, 112, 123, 181, 183, 260, 231, 248, 266, 268  
- Organismic and Evolutionary Biology: OEB 55, 120, 157  
- Physics: PHY 129  
- Introductory Engineering Sciences Courses (no more than one): ES 50, 51, 53  
- Upper-level Applied Math (no more than one): AM 105, 115

† Students are strongly encouraged to acquire competency in this area before taking upper-level ESE courses with programming and data analysis components.

*With permission of the DUS, up to two elective courses may be substituted with a relevant upper-level course from other areas of the natural sciences and engineering. Students are allowed to develop their own thematic plan and petition for DUS approval.*
Required Signatures:

__________________________________________  Date
Student

__________________________________________  Date
Assistant Director of Undergraduate Studies

ADUS indicate if a petition is needed:  Yes___ No___

__________________________________________  Date
Director of Undergraduate Studies
COURSE TITLES FOR APPROVED ELECTIVES:

ESE 101 – Global Warming Science 101
ESE 102 – Data Analysis and Statistical Inference in the Earth and Environmental Sciences
ESE 109 – Earth Resources and the Environment
ESE 115 – Ecosystem Patterns and Processes: Parallels in Natural and Built Environments
ESE 129 – Climate and Atmospheric Physics Lab
ESE 131 – Introduction to Physical Oceanography and Climate
ESE 132 – Introduction to Meteorology and Climate
ESE 133 – Atmospheric Chemistry
ESE 138 – Mysteries of Climate Dynamics
ESE 160 – Space Science and Engineering: Theory and Applications
ESE 161 – Introduction to Physical Oceanography and Climate
ESE 162 – Introduction to Meteorology and Climate
ESE 163 – Atmospheric Chemistry
ESE 165 – Applied Environmental Toxicology
ESE 166 – State-of-the-art Instrumentation in Environmental Sciences
ESE 168 – Human Environmental Data Science: Agriculture, Conflict and Health
ESE 169 – Field and Lab-based Seminar on Local Pollution Issues

ES 91r – Supervised Reading and Research
ES 96 – Engineering Problem Solving and Design Project
ES 112 – Thermodynamics
ES 123 – Intro to Fluid Mechanics & Transport Processes
ES 181 – Engineering Thermodynamics
ES 183 – Introduction to Heat Transfer
ES 231 – Energy Technology (Graduate level)
ES 248 – Electrochemistry (Graduate level)
ES 260 – Atmospheric Chemistry and Physics (Graduate level)
ES 266 – Environmental Modeling (Graduate level)
ES 268 – Physics of Climate (Graduate level)

EPS 53 – Marine Geochemistry
EPS 134 – Global Warming Debates: The Reading Course
EPS 187 – Biogeochemistry

OEB 55 – Ecology: Populations, Communities, and Ecosystems
OEB 120 – Plants and Climate
OEB 157 – Global Change Biology

AM 10 – Computing with Python for Scientists and Engineers
AM 101 – Statistical Inference for Scientists and Engineers
AM 105 – Ordinary and Partial Differential Equations
AM 115 – Mathematical Modeling
AM 120 – Applied Linear Algebra and Big Data

STAT 110 – Introduction to Probability
STAT 111 – Introduction to Statistical Inference

CS 32 – Computational Thinking and Problem Thinking
CS 50 – Introduction to Computer Science
CS 109A – Data Science 1: Introduction to Data Science
CS 109B – Data Science 2: Advanced Topics in Data Science

SCI 5 – An Introduction to Computation for Contemporary Science
SCI 6121/6122 – Environmental Systems (must take both; Graduate School of Design)
<table>
<thead>
<tr>
<th>Gateway Course</th>
<th>Math</th>
<th>Chem.</th>
<th>Physics</th>
<th>Other</th>
<th>Prog. Lang.</th>
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</thead>
<tbody>
<tr>
<td>ESE 6</td>
<td>Fall</td>
<td>1b</td>
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<td>R/Python</td>
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<th>Selected Electives</th>
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<tr>
<td>ESE 50</td>
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<tr>
<td>ESE 101</td>
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<td>ESE 102</td>
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<tr>
<td>ESE 109</td>
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<td>(ESE 6 or EPS 10)</td>
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<td>MATLAB</td>
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<tr>
<td>ESE 115</td>
<td>Spring</td>
<td>1b</td>
<td>(PS 11)</td>
<td>(ESE 6)</td>
<td>R / Python</td>
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<tr>
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<td>(21a)</td>
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<td>(A)</td>
<td>Python</td>
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<td>Python</td>
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<td>PS 11</td>
<td>A,B</td>
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<td>(PS 11)</td>
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<tr>
<td>ESE 169</td>
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<td>PS 11</td>
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<td>Preference given to SB students</td>
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<td>ES 96</td>
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<td>ES 112</td>
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<td>ES 181</td>
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<td>AM 101</td>
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<td>AM 105</td>
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<td>MATLAB</td>
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<tr>
<td>AM 115</td>
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<td>AM 120</td>
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<td>CS 32, 50; AM 10; SCI 5</td>
<td>Python / MATLAB</td>
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<td>STAT 111</td>
<td>Fall/Spring</td>
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<td>STAT 110</td>
<td>R</td>
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1. Courses listed as Recommended Preparation, and not enforced prerequisites, are shown in parentheses.
2. Equivalent courses are accepted for prerequisites (e.g., Phys 15a, PS 12a, or AP50a all count for Physics A).
3. Programming language indicates the default language used for instruction (not prerequisites).
4. Please check out [https://info.seas.harvard.edu/courses/four-year-plan](https://info.seas.harvard.edu/courses/four-year-plan) each semester.