Plan of Study for the Environmental Science & Engineering AB Concentration

Effective for Students Declaring the Concentration after August 1, 2023

NAME: _____ CLASS: _____ EMAIL: _____ DATE: _____

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

Please describe your academic theme:

REQUIRED COURSES	**Semester** (FA/SP Year)	**Selected Course**
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 (2 courses) LPS A – Foundational Chemistry and Biology (or LS 1a – An Integrated Introduction to the Life Sciences) PS 11– Foundations and Frontiers of Modern Chemistry ***(strongly recommended)*** CHEM 10 – Quantum and Statistical Foundations of Chemistry CHEM 17 – Principles of Organic Chemistry (or Chemistry 20 – Organic Chemistry)		
Gateway Course (1 course) ESE 6 – Intro to Environmental Science & Engineering ***(strongly recommended)*** (With permission of the DUS, may be substituted by an additional course in Env. Phy., Env. Chem., or taking ESE 50)		
Sophomore Forum (*Required, non-credit; Taken in Sophomore Spring)*	SP ___	
Breadth in Environmental Science & Engineering (2 courses) *With permission of the DUS, students may substitute alternative ESE courses.* *One course on environmental physics:* ESE 101,129, 131, 132, 162, ES 112 *One course on environmental chemistry:* ESE 133, 161, 164		
Approved Electives (5 courses)		

REQUIRED COURSES	**Semester** (FA/SP Year)	**Selected Course**
*Select five from the options below. With permission of the DUS, up to two courses may be substituted with a relevant upper-level course from other areas of the natural sciences and engineering. Courses marked with an * are approved for the required design experience (see below).* • ESE 101, 102, 109, 115, 129, 131, 132, 133, 138, 160*, 161, 162, 163*, 164, 166*, 168, 169* • Data analytics, statistics, and scientific computing† (no more than one): AM10, 101, 120; CS 32, 50, 109a, 109b; SCI 5; Stat 110 • Engineering Sciences: ES 91r (one term), 96*, 112, 123, 181, 183 • Earth and Planetary Sciences: EPS 53, 134, 187 • Organismic and Evolutionary Biology: OEB 55, 120, 157 • 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.*		
Design Experience *All students must take an approved course (see courses marked with an * above) with significant design experience as one of their ESE Breadth or Approved Electives. This requirement may also be satisfied with a design component within a senior thesis or independent research project (ES 91r).*		

Required Signatures:

_____ _____

Student Date

_____ _____

Assistant Director of Undergraduate Studies Date

ADUS indicate if a petition is needed: Yes___ No___

_____ _____

Director of Undergraduate Studies Date

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 122 – Designing Satellite Missions: Research Methods through Lens of Earth Observing Systems
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 – Applied Environmental Toxicology
ESE 162 – Hydrology
ESE 163 – Pollution Control in Aquatic Ecosystems
ESE 164 – Environmental Chemistry
ESE 166 – State-of-the-art Instrumentation in Environmental Sciences
ESE 168 – Human Environmental Data Science: Agriculture, Conflict and Health
ESE 169 – Seminar on Global Pollution Issues

ES 50 – Introduction to Electrical Engineering
ES 51 – Computer-Aided Machine Design
ES 53 – Quantitative Physiology as a Basis for Bioengineering
ES 91r – Supervised Reading and Research
ES 96 – Engineering Problem Solving and Design Project
ES 112 – Thermodynamics by Case Study
ES 123 – Intro to Fluid Mechanics & Transport Processes
ES 181 – Engineering Thermodynamics
ES 183 – Introduction to Heat Transfer

EPS 53 – Marine Geochemistry
EPS 134 – Global Warming Debates: The Reading Course
EPS 187 – Low Temperature Geochemistry II: Modern and Ancient Biogeochemical Processes

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

	Typically Offered	Math	Chem.	Physics	Other	Prog. Lang.
Gateway Course						
ESE 6	Spring					R
Selected Electives						
ESE 50	Fall					
ESE 101	Spring	*(1b)*				Python
ESE 102	Spring	*(21a,b)*				R / Python
ESE 109	Spring (odd)				*(ESE 6 or EPS 10)*	MATLAB
ESE 115	Fall	1b	*(PS 11)*		*(ESE 6)*	R / Python
ESE 129	Spring (Odd)	*(21a)*		*(A)*		Python
ESE 131	Spring (even)	21a,b		A		Python / MATLAB
ESE 132	Fall (even)	21a,b		A		
ESE 133	Spring	1b	PS 11			
ESE 138	Fall (odd)	21a,b		A		
ESE 160	Fall (odd)	21a,b		A,B		Python/MATLAB
ESE 161	Spring	1a or 1b	PS 11			
ESE 162	Fall (even)	21a,b		A		
ESE 163	Fall (even)	21a			*(ESE 6)*	
ESE 164	Fall		PS 11			
ESE 166	Fall (even)	1b	PS 11	A,B		
ESE 168	Fall	*(1b)*	*(PS 11)*	*(A)*		Python / MATLAB
ESE 169	Fall	1a or 1b	PS 11			Python
ES 96	Fall/Spring				Preference given to SB students	
ES 112	Spring					
ES 123	Spring	21a		A		Python
ES 181	Fall			A		
ES 183	Spring	21a,b		A		MATLAB
AM 101	Fall	21a				MATLAB
AM 105	Spring	21a,b				MATLAB
AM 115	Spring	21a,b			*(AM 104,105,108; AM115; STAT 110)*	MATLAB
AM 120	Spring	21a,b			CS 32, 50; AM 10; SCI 5	Python / MATLAB
STAT 110	Fall	1b				R
STAT 111	Spring				STAT 110	R

[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 each semester.