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.

REQUIRED COURSES (Circle or fill-in for courses planned in each category.)	**Math**	**Science**	**Engr. Topics**	**Semester** (FA/SP Year)
Mathematics (2-4 courses) *Begin according to placement:* Math 1a – Introduction to Calculus I Math 1b – Calculus, Series, and Differential Equations AM 21a – Mathematical Methods in the Sciences I (or Mathematics 21a or 23a) AM 21b – Mathematical Methods in the Sciences II (or Mathematics 21b or 23b)	 1.0 1.0 1.0 1.0			 _____ _____ _____ _____
Probability & Statistics (1 course, if starting in Math 1b or higher) *Select one (ES150 preferred for Electrical Subtrack*): AM 101 – Statistical Inference for Scientists & Engineers ES 150 – Intro to Probability with Engineering Applications Statistics 110 – Introduction to Probability	(1.0)			_____
Applied Mathematics (1course, if starting in Math 21a or equivalent) *Select one:* AM 104 – Series Expansions & Complex Analysis AM 105 – Ordinary & Partial Differential Equations AM 106 – Applied Algebra AM 107 – Graph Theory & Combinatorics	(1.0)			_____
Physics (2 courses) AP 50a – Physics as a Foundation for Sci. & Eng. Part I (or PS 12a or Physics 15a or 16) AP 50b – Physics as a Foundation for Sci. & Eng. Part II (or PS 12b or Physics 15b)		 1.0 1.0		 _____ _____
Computer Science (1 course) *Select one:* CS 50 – Introduction to Computer Science I CS 51 – Introduction to Computer Science II CS 61 – Systems Programming & Machine Organization			1.0	_____

REQUIRED COURSES (Circle or fill-in for courses planned in each category.)	**Math**	**Science**	**Engr. Topics**	**Semester** (FA/SP Year)
Chemistry/Life Sciences (2 courses) *Select two (either Chemistry 17 or 20 is required for the Chemical & Materials Subtrack):* LS 1a – Intro to the Life Sciences (or LPS A – Foundational Chemistry & Biology) LS 1b – Genetics, Genomics, and Evolution PS 10 – Chemistry: A Microscopic Perspective PS 11 – Foundations & Frontiers in Modern Chemistry (or PS 1 – Chemical Bonding, Energy, & Reactivity) CHEM 17 – Principles of Organic Chemistry (or CHEM 20 – Organic Chemistry)		1.0 1.0		_____ _____
Sophomore Forum *Required, non-credit.*				_____
Bioengineering Core: Physiology & Modeling (2 courses) ES 53 – Quantitative Physiology as a Basis for Bioengineering BE 110 – Physiological Systems Analysis			1.0 1.0	_____ _____
Subtrack-specific Courses (4 courses) *Select one Subtrack:* • *Mechanical Subtrack* o ES 120 – Intro to the Mechanics of Solids o ES 123 – Intro to Fluid Mechanics o ES 181 – Engineering Thermodynamics o BE 191 – Intro to Biomaterials (*preferred*) (or ES 190 – Intro to Materials Science & Eng.) • *Electrical Subtrack* o ES 54 – Electronics for Engineers (or ES 153 (or both of ES 152 and CS 141)) o Signals and systems courses (*select two)*: BE 128 – Biomedical Imaging and Systems, BE 130 – Neural Control of Movement, ES 157 – Biological Signal Processing o Another approved EE course (if ES 54/153 is taken) *(see last page for list of EE electives)*_____ • *Chemical & Materials Subtrack* o BE 121 – Cellular Engineering (or BE 125 – Tissue Engineering) o ES 123 – Intro to Fluid Mechanics o ES 181 – Engineering Thermodynamics (or ES 112 – Thermodynamics by Case Study) o BE 191 – Intro to Biomaterials (*preferred*) (or ES 190 – Intro to Materials Science & Eng.)			1.0 1.0 1.0 1.0	_____ _____ _____ _____
Approved Engineering Electives* (3 courses) *Select three courses, at least two at the 100- or 200- level, from the list on pages 4-5.* 1.			1.0	_____

REQUIRED COURSES (Circle or fill-in for courses planned in each category.)	**Math**	**Science**	**Engr. Topics**	**Semester** (FA/SP Year)
2.			1.0	_____
3.			1.0	_____
Engineering Design (2 courses)				
ES 96 or ES 227 (*one must be taken prior to senior year*)			1.0	_____
ES 100hf (*taken both semesters during senior year*)			1.0	_____
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

<u>Engineering Courses</u>

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