BIOENGINEERING Undergraduate Advising Guide

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http://www.cbee.oregonstate.edu/

Oregon State UNIVERSITY OSU

Our Mission is to graduate students immediately prepared for professional practice.

Bioengineering

General Information

Bioengineering. Bioengineering is an interdisciplinary field that applies engineering principles and quantitative methods to the advancement of knowledge at the molecular and cellular levels through the ecosystem level, and to the development of new and novel biologicals, materials, devices, and processes. In practice, bioengineers address issues in the broad areas of bioenvironmental, biomedical, and bioprocess technology. Bioenvironmental engineers may be involved in design and analysis of waste treatment operations using natural systems, by application of constructed wetlands or hydroponics, for example. Biomedical engineers work on highly visible problems in drug formulation and delivery, construction of vital organs with natural and synthetic components, and medical device design among many others. Bioprocess engineers are involved in production of novel products such as therapeutic proteins and biodegradable plastics. Our bioengineering program uses biomedical, bioprocess, and bioenvironmental applications as themes for delivering fundamental science and engineering concepts.

Career opportunities for bioengineers. Career opportunities for bioengineers exist in the biotech and biomedical industries, clinical institutions, and government agencies. Growth in the Pacific Northwest's biotech and biomedical industry is currently about 30% per year, with as many as 25 new companies forming in the region each year. It is expected that by the year 2020, about 35% of US industry will be medically or biology-based. According to the US Labor Department, the largest demand for engineers through 2008 will be in the medical instrument and supply industries. Engineering jobs in the medical sector are forecast to increase by 33.4 percent during the 10-year period from 1998 to 2008, while overall demand for engineers in industry will increase by 19.9 percent. With a shortfall projected for qualified bioengineers, graduates from this program should encounter little trouble in finding employment. In addition, OSU-trained bioengineers will be prepared to enter graduate school in chemical, environmental, or bioengineering, enter veterinary or dental programs, or attend medical school.

The Program

The Bioengineering undergraduate program (initiated in 1996 as biological engineering) provides a solid background in biology (anatomy and physiology, biochemistry, molecular and cellular biology), chemistry, physics and math, in addition to the engineering sciences. Upper-level course work in bioengineering includes analysis and design of processes involving suspension and immobilized microbial cultures and the recovery of therapeutic products from bioreactors, as well as selection courses in mammalian cell culture and tissue engineering, biomedical materials engineering and biofluid mechanics. All students complete coursework in drug and medical device regulation as well as a capstone-design experience. Bioengineering graduates are prepared to contribute to the rapidly growing bioscience-based industries, able to formulate and solve problems relevant to the design of devices and systems to improve human health.

The excellence of the program is evident in that a large majority of the students have either received offers of employment or decided to pursue graduate education. Graduates of the BIOE Program work in design, production, research and development, sales, and management positions. A few of the employers of OSU BIOE Alumni are:
Amgen
Anheuser Busch
AVI BioPharma
Bend Research
Berlex Laboratories
Boston Scientific
Electrical Geodesics Inc.
Hewlett Packard
Oregon Freeze Dry
Oregon Medical Laser Center
SigA

For those students whose professional goals include higher level engineering positions, engineering research, or engineering education, the bioengineering curricula provides an excellent background for graduate school. Many OSU BIOE graduates have been offered admission to and have gone on to study at such institutions as Cornell University, Duke University, Georgia Institute of Technology /Emory, Massachusetts Institute of Technology, University of California - San Diego, University of Utah, University of Washington, and University of Wisconsin, just to

name a few. Several alumni are pursuing medical degrees at institutions such as Creighton University, Johns Hopkins University, Ohio State University, Oregon Health and Sciences University, and Stanford University.

Program educational mission and objectives. The School's undergraduate educational mission is to provide a high quality engineering program that prepares students for successful careers, lifelong learning, and service to their profession and society. In particular, the department seeks to provide the biotech and biomedical industries, as well as clinical institutions, government agencies and universities, with highly qualified professionals whose unique expertise will foster the continued viability and growth of these entities.

OSU bioengineering graduates will be known for their technical competence and creativity; for their ability to apply, adapt, and extend their knowledge to solve a wide variety of problems; and for their effective communication skills. Their education will provide them with an understanding of the ways in which the humanities, social sciences, basic services, and technology interact to affect society. This program will foster an environment that stimulates learning and promotes diversity.

The Program objectives of the Bioengineering program follow:

1. Graduates will be work-ready B.S. engineers who are successful in obtaining employment in the bioprocess and biotechnology industries, in entering graduate studies in bioengineering, chemical, environmental, and biomedical engineering and gaining admission to professional schools including health-professional programs and law programs..
2. Graduates will be able to solve problems at the interface of engineering and biology whether in a manufacturing, research, or clinical environment.
3. Graduates will be motivated to pursue life-long learning efforts in order to fulfill their professional and ethical responsibilities, and they will recognize their responsibility to understand contemporary questions at the interface of biosciences, technology, and society.
4. Graduates will be able to effectively communicate with a diverse set of professionals, able to facilitate meaningful collaboration between bioscientists and other engineers.
5. Graduates will have careers that significantly contribute to society no matter the direction or environment they choose because of their broad education based in science and engineering.

Curriculum

The requirements for the BS degree in Biongineering reflect the knowledge and skills necessary for the new engineer to take his or her place in society. General requirements are established by the College of Engineering (COE) and Oregon State University. The School of Chemical, Biological, and Environmental Engineering determines the specific requirements for graduation and audits those courses to ensure that the standards of the **Accreditation Board for Engineering and Technology (ABET)** are met by every student who receives a degree.

ABET is the national organization that accredits—or certifies—engineering and technology degree programs. ABET's Engineering Accreditation Commission (EAC) applies standards set by practicing engineers and engineering educators to specify the general form and content of engineering programs. The School of Chemical, Biological and Environmental Engineering, with the advice of the bioenvironmental, biotech and biomedical device industries, determines the courses needed to help the student develop the knowledge and skills required of the modern bioengineer. In several situations the School's regulations are more restrictive than the University's regulation.

The University (OSU) establishes a set of core requirements - called the Baccalaureate Core - which all undergraduate degree programs at OSU must incorporate. These requirements help the student develop the values, knowledge, and skills that all university graduates should possess. The current requirements are published each quarter in the Schedule of Classes for that quarter.

The following pages list the Bioengineering curriculum by the categories that are used for ABET accreditation. In both the *Oregon State University Bulletin* and the OSU College of Engineering *Advising Guide* (http://www.engr.oregonstate.edu/advising/), you will find the same curriculum. Copies of the Curriculum Check Sheet for the bioengineering curriculum and the Curriculum Block Diagram are included in this guide. The official checklist is maintained in the main office. Please note that just because a course is required or recommended in the curriculum does not mean that it will be offered every term. Also, most courses have prerequisites, courses that must be completed satisfactorily before the course can be taken. Always consult the *Oregon State University Bulletin* or the OSU *Schedule of Classes*, or check with the appropriate department for availability and prerequisites before registering for a course.

Before registering for any restricted elective course, even a recommended course, consult with your advisor.

Explanation of BIOE Curriculum

Mathematics and statistics. Mathematics provides an important base for bioengineering. Required mathematics courses cover calculus through differential equations. Statistics for Engineers (ST 314) includes material on probability and statistics, two important tools used by bioengineers in the analysis of process data. Students having completed a strong high school program in mathematics typically begin at the level of differential calculus (MTH 251). Students with a limited background in math should first complete preparatory coursework prior to taking MTH 251, such as MTH 111 College Algebra or MTH 112 Elementary Functions. Unfortunately credit earned in such preparatory courses cannot be used to fulfill the math credit requirements for the bioengineering program.
NO mathematics course may be taken S/U.

Basic Science. BIOE students are expected to have had a strong chemistry background in high school and are required to take CH 221, 222 and 223, which are 5-credit courses offered by the Chemistry department specifically for chemistry and some engineering majors during their first year of study. In some cases transfer students may have prior credit for CH 121-123, CH 201-202, or some combination of these courses, but not CH 221-223. These students may fulfill the CH 221-223 requirement by ensuring they have completed 15 credits of general chemistry or a combination of general chemistry and upper-division chemistry. This combination must be articulated and sent through the formal petition process.

All engineering majors are required to take PH 211, PH 212 and PH 213 calculus-based physics courses. These courses are part of the pre-engineering core and must be completed before entering the professional engineering program.

The BIOE program does not require completion of the introductory biology series (BI 211-213), mainly a result of the limited number of credit hours available, and our program's focus on molecular and cellular biology. Bioengineering students are better served by simply completing BI 314 and selected upper-division bioscience courses. Students, who are interested in a pre-med, pre-dental or pre-vet track, should complete the introductory sequence, however. In addition, those with a limited background in biology are encouraged to complete the introductory series or at least BI 212. Note that bioengineering majors are waived from the biological science baccalaureate core requirement.

NO science course, required or selection, may be taken S/U.

Upper-division biosciences. BIOE students must take advanced bioscience selection courses beyond those that are prescribed. These courses must be listed as a 300- or 400-level course, have a substantial bioscience content and cannot be courses which are classified as engineering topics.

Acceptable Upper-Division Bioscience Courses from which students may select

BIOE	442	Lab	(4)	Medical Science for Engineers II
BI	311		(4)	Genetics
MB	302		(3)	General Microbiology
MB	303	Lab	(2)	General Microbiology Laboratory

A petition to the Head Advisor of Bioengineering is required to use a class outside of the list above. NO bioscience selection course may be taken S/U.

Engineering Topics: ***Engineering Science & Design.*** These courses cover concepts and techniques that are essential to engineering analysis and design. More importantly they cover the *philosophy and process* of engineering problem solving. In particular, students develop a comprehensive understanding of engineering fundamentals and applications by taking a minimum of 73-credit hours of engineering coursework, including courses that cover:

- design practices, policy and regulations, emerging areas in bioengineering, computer tools, technical communications, engineering economics and project management (BIOE 111, 407, 470 and 490, CHE 102, ENGR 390);
- mechanics and electrical engineering fundamentals (ENGR 201 and 211);
- material and energy balances, fundamentals of thermal sciences, momentum, mass and energy transfer, (BIOE 211, CHE 311 and 323, ENGR 332 and 333);
- professional engineering ethics as well as social ethics in engineering (BIOE 220 and 420); and
- bioreactor design and bioseparation processes (BIOE 457 and 462), with 7 credits of selection coursework available in biomedical materials, cell culture and tissue engineering, metabolic engineering, and biofluid mechanics (BIOE 451, 458, 460, 466, respectively).

Students are offered a menu of engineering courses from which to choose an additional 15 credits of engineering topics. Students may judiciously choose the coursework to emphasize an area of application within bioengineering which interests them. For example, students interested in biomechanics may elect to enroll in dynamics, strength of materials, engineering graphics and 3-D modeling, and biomechanics (ENGR 212, 213 and 248, BIOE 450).

Acceptable Engineering Topics / Courses from which students may select

CHE	213	(4)	Material and Energy Balance Laboratory
CHE	312	(3)	Chemical Engineering Thermodynamics
CHE	361	(3)	Data acquisition and process dynamics
CHE	417	(4)	Instrumentation in Chemical, Biological & Environmental Engineering
CHE	445	(4)	Polymer Engineering and Science
CHE	461	(3)	Process Control
ENGR	212	(3)	Dynamics
ENGR	213	(3)	Strength of Materials
ENGR	248	(3)	Engineering Graphics and 3-D Modeling
BIOE	450	(4)	Biomechanics
BIOE	451	(4)	Biomaterials
BIOE	458	(4)	Cell Culture and Tissue Engineering
BIOE	460	(3)	Metabolic Engineering
BIOE	466	(3)	Biofluid Mechanics
ENVE	421	(4)	Water and Wastewater Characterization
ENVE	422	(4)	Environmental Engineering Design
ENVE	425	(3)	Air Pollution Control
ENVE	431	(3)	Fate and Transport of Chemicals in Environmental Systems

Note that credits used to satisfy the Upper-Division BIOE selection requirement cannot be used to satisfy the engineering topics credit requirement. A petition to the Head Advisor of Bioengineering is required to use a class outside of the list above. No engineering topics course may be taken S/U.

Communication Skills. The best technical work is worthless if it cannot be communicated to others for evaluation and implementation. Many engineers find that they spend more time communicating – meeting and working with colleagues, writing memos and reports, and giving presentations – than they do in technical problem solving. For that reason, the bioengineering curricula requires courses in basic writing, technical report writing, and public speaking. Every undergraduate at OSU must complete an upper-division course (in their discipline), which meets the requirements for "writing-intensive" status. BIOE 490, Bioengineering Design, serves as the writing-intensive course for bioengineering students. NO communication skills course may be taken S/U.

Humanities and Social Sciences. It is the University's role to prepare students to take an active, constructive part in society. To fulfill that role, it must provide engineering students with the technical knowledge and skill that they will need to function as engineers. But engineers must have more than just technical skills. Like any citizen, engineers have a great responsibility to society. To meet that responsibility, they must have a basic understanding of individual and social behavior and values and cultures of the society. For that reason, each engineering curricula requires courses in humanities and social sciences.

The baccalaureate core is part of every undergraduate program at OSU, and emphasizes writing, creative thinking, cultural diversity, the arts, sciences, literature, lifelong fitness and global awareness. Substantial coursework within this core deals with humanities and social sciences, and is identified within one of three categories: "Perspectives," "Difference, Power, and Discrimination" and "Synthesis." The nature of these requirements, along with a listing of acceptable courses in each category, can be found in the *OSU General Catalog*.

Perspectives Courses: A total of 4 Perspectives courses, totaling at least 12 credits, must be taken. This includes a minimum of 1 course in each of the following categories: Western Culture, Cultural Diversity, Literature and the Arts, and Social Processes and Institutions. In fulfilling the Humanities and Social Sciences requirements, a maximum of two courses may be selected from the same department.

Difference, Power, and Discrimination Course (DPD): Students must complete, with a grade of "C-" or better one DPD course from the following list: AG 301; ANTH 251; ANTH 345; ANTH 345H; ANTH 451; ECON 383; ENG 420; ES 212; ES 213; ES 216; ES 221; ES 223; ES 232; ES 243; ES 351; ES 452; FW 340; H 465; HST 368; LING 251; MB 330; PHL 280; PHL 380; PS 363; PS 375; SOC 312; SOC 312H; SOC 426; TA 360; TCS 200; WS 414; WS 420.

Synthesis Courses: Two Synthesis courses must be taken: one course in Contemporary Global Issues and one course in Science, Technology, and Society. NO COURSE listed as an OSU "synthesis" course can be used as an Upper-Division Bioscience selection or an Engineering Topic selection.

Except for the DPD course, Humanities and Social Sciences courses may be taken S/U. An absolute maximum of 36 credits of S/U may be taken if a student has four years of full-time study at OSU. For transfer students the maximum is 3 times the number of quarters of full-time residency at OSU.

Fitness. The OSU Baccalaureate Core requires that all OSU students take HHS 231 and HHS 24x, Lifetime Fitness Lab. HHS 231 and 24x maybe taken S/U.

Curriculum Block Diagram for BS Program. The 192 course credits required for the B.S. degree in bioengineering are listed in Table 1. A block diagram (Figure 1) following this table provides an example of how a program might be constructed, term by term. Each column represents one academic quarter. The first two years in the program are the pre-engineering program. The gray shaded courses comprise the "core" courses used to calculate a GPA used for admission to the professional program. The courses shaded in green represent classes needed to satisfy the general education requirements. The sequence of courses in the third and fourth years represents the professional program. This flowchart represents an idealized schedule, and most students' actual schedules will differ in sequence and number of quarters required to satisfy all requirements. In particular, students interested in the MECOP program, (and/or other work opportunities) must carefully plan their schedules with the MECOP advisor to ensure timely graduation.

B.S. in Bioengineering - Course Requirements

Baccalaureate Core (33 credit hours)

Perspectives, DPD, and Synthesis		21
Writing:	WR 121 English Composition*	3
	WR 327 Technical Writing	3
Speech:	COMM 111 Public Speaking*; **or**	
	COMM 114 Argument and Critical Discourse*	3
Lifetime Fitness:	HHS 231, 24X	3

Mathematics and Statistics (24 credit hours)

MTH 251, 252	Differential Calculus*; Integral Calculus*	8
MTH 254, 306	Vector Calculus I*; Matrix and Power Series methods*;	8
MTH 256	Applied Differential Equations*	4
BIOE 213	Process Data Analysis	4

Chemistry and Physics (35 credit hours)

CH 221-223	General Chemistry (* 221 only)	15
CH 331-332	Organic Chemistry	8
PH 211-213	General Physics with Calculus*	12

Biological Sciences (24 credit hours)

Z341,342,343	Anatomy & Physiology Lab **OR**	2
MB 230	Introduction Microbiology	4
BB 450-451	General Biochemistry	7
BB 493-494	Biochemistry Laboratory	6
BIOE 340	Biomedical Engineering Principles	3
Z 331	Zoology	3
Z 333	Zoology	3

Engineering Sciences (33 credit hours)

BIOE 102	Engineering Problem Solving and Computation	3
CHE 311	Thermodynamics	3
CHE 331	Transport I Fluids	4
CHE 332	Transport II Heat & Mass	4
CHE 333	Transport III Lab	3
ENGR 201	Electrical Engineering Fundamentals*	3
ENGR 211	Statics*	3
ENGR electives	Select 10 credits from the following: BIOE 450; BIOE 451, BIOE 459, BIOE 485; CHE 312, CHE 361, CHE 445, CHE 461; ENGR 212, ENGR 213, ENGR 248; ENVE 421, ENVE 422, ENVE 425, ENVE 431	10

Biological Engineering Core Courses (43 credit hours)

BIOE 101	Bioengineering Orientation	3
BIOE 211	Mass and Energy Balances	3
BIOE 212	Elements of Transport and Kinetic Processes	3
BIOE 320	Bioengineering Ethics and Professionalism	3
BIOE 390	Bioengineering Product Design	4
BIOE 414	Process Engineering Laboratory	3
BIOE 415	Bioengineering Laboratory	3
BIOE 420	Social Ethics in Engineering	3
BIOE 457	Bioreactors	3
BIOE 462	Bioseparations	3
BIOE 470	Regulation of Drugs and Biomedical Devices	2
BIOE 490	Bioengineering Design	4
BIOE electives[#]	Select 6 credits from the following : BIOE 451, BIOE 458, BIOE 459, BIOE 485	6

TOTAL CREDIT HOURS – 192

* Required by the College of Engineering for admission to the professional program

[#] Note that credits used to satisfy this requirement cannot be used to satisfy the ENGR elective requirement

* Required by the College of Engineering for admission to the professional program

BIOENGINEERING CURRICULUM Example (192 credits)

Cr.	First Year (48 credits)			Second Year (49 credits)			Third Year = 49 credits			Fourth Year = 46 credits		
	Fall	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**
1	*General Chemistry CH 221 (5F)	General Chemistry CH 222 (5W)	General Chemistry CH 223 (5S)	Organic Chemistry CH 331 (4)	Organic Chemistry CH 332 (4)	* Statics ENGR 211 (3)	General Biochemistry BB 450 (4F)	General Biochemistry BB 451 (3)	Biomedical Engr Principles BIOE 340 (3S)	Biochem Lab BB 493 (3F)	Biochemistry Lab BB 494 (3)	Bioegnineering Design BIOE 490 (4S)
2												
3												
4				Anatomy & Physiology Z331 (3)	*Applied Diff Equations MTH 256 (4)	*Matrix & Power Series Methods MTH 306 (4)	Transport 1 CHE 331 (4F)	Transport II Heat & Mass Transfer CHE 332 (4W)	Transport III CHE 333 (3S)	Bioereactors BIOE 457 (3F)	Bioe Lab BIOE 415 (3W)	BIOE Elective[2] (3)
5												
6	*Differential Calculus MTH 251 (4)	*Integral Calculus MTH 252 (4)	*Vector Calculus MTH 254 (4)	*General Physics PH 212 (4)	*General Physics PH 213 (W()	*Electrical Eng Fundamentals ENGR 201 (3)	Thermodynamics CHE 311 (3F)	Technical writing WR 327 (3)	Social Ethics in ENGR BIOE 420 (3)	Biosep BIOE 462 (3F)	Reg of drugs BIOE 470 W (2)	ENGR Elective[1] (4)
7												
8											BIOE selection[2] (3W)	
9												
10	Bioe Orient BIOE 101 (3F)	*Engr problem solving BIOE 102 (W3)	*General Physics PH 211 (4)	Mat Balances BIOE 211 (3F)	Energy Balances BIOE 212 (3W)	Process Data Analysis BIOE 213 (4S)	Professionalism & ENGR Ethics BIOE 320 (3F)	Engineering selection[1] (3)	Bioengineering product design BIOE 390 (4S)	BIOE Lab BIOE 414^ (3F)	Perspectives (3)	Synthesis (3S)
11												
12												
13	*English composition WR 121 (3)	Biology Selec[4] (2 or 4)	*Speech Comm COMM 111/114 (3)	Life Fit HHS 231 (2FWS)		Anatomy & Physiology Z 333 (S3)	Engineering selection[1] (3)	Perspectives (3)	DPD [3] (3)	Perspectives (3)		Synthesis (3S)
14												
15		Perspectives (3)										
16				HHS 24* (1)								
17												
18												
19												

*Required for admission into the Bioengineering Professional Program. We'll accept the combination of MTH 253 and MTH 341 as equivalent to MTH 306.

^Satisfies the WIC requirement

Univ & College Core

[1]**Engineering courses from which students may select (at least 10 credits).**	[2]**Upper division BIOE courses from which students may select (at least 6 credits). Note that courses used to satisfy this requirement CANNOT be used to satisfy the engineering science selection.**	[3]**Difference, power and discrimination courses from which students may select (at least 3 credits).**	[4]**Biology courses from which students may select (one course only)**
CHE 312(3), CHE 361(3), CHE 416, CHE 445 (4), CHE 461(3), ENGR 212(3), ENGR 213 (3), ENGR 248 (3), BIOE 450 (4), BIOE 451(4), BIOE 458 (3), BIOE 459 (3), BIOE 485 (3), ENVE 421 (4), ENVE 422 (4), ENVE 425 (3), ENVE 431 (3)	BIOE 451(3), BIOE 459(3), BIOE 458(3), BIOE 485(3)	AG301(3),ANTH251/345/345H/451(3) ECON383(4),ENG420(3) ES212/213/216/221/223/232(3) ES 243/351/452(3), FW340(3),H465(3) HST368(3),LING251(3),MB330(3), PHL280(4),PS375(4),SOC312/312H(3), SOC360/426(3),TA360(3),TCS200(3) WS414/420(3)	Anatomy and Physiology Laboratory (Z 341, Z 342, or Z 343) 2 credits Introductory Microbiology (MB 230) 4 credits

Curriculum Check Sheet
Bioengineering Courses

Student's Name: _____ **Form Completed By:** _____
Student ID #:_____ **Date:** _____

Required BIOE Courses (44 credits)
BIOE 101 (3)_____
BIOE 102 (3)_____
BIOE 211 (3)_____
BIOE 212 (3)_____
BIOE 213 (4)_____
BIOE 320 (3)_____
BIOE 340 (3)_____
BIOE 390 (4)_____
BIOE 414 (3)_____
BIOE 415 (3)_____
BIOE 420 (3)_____
BIOE 457 (3)_____
BIOE 462 (3)_____
BIOE 470 (2)_____
BIOE 490 (4)_____

Engineering Topics (20 credits)
CHE 311 (3)_____
CHE 331 (4)_____
CHE 332 (4)_____
CHE 333 (3)_____
ENGR 201 (3)_____
ENGR 211 (3)_____

BIOE Courses – Restricted Elective (6 credits)
_____( )_____
_____( )_____
BIOE 451, BIOE 458, BIOE 459, BIOE 485

Engineering Topics – Restricted Elective (10 credits)
_____( )_____
_____( )_____
_____( )_____
_____( )_____

BIOE 450, BIOE 451, BIOE 458, BIOE 460
CHE 213, CHE 312, CHE 361, CHE 417, CHE 445, CHE 461
ENGR 212, ENGR 213, ENGR 248,
ENVE 322, ENVE 421, ENVE 422, ENVE 425, ENVE 431

Mathematics (20 credits)
MTH 251 (4)_____
MTH 252 (4)_____
MTH 254 (4)_____
MTH 256 (4)_____
MTH 306 (4)_____

Fitness (3 credits)
HHS 231 (2)_____
HHS 24x (1)_____

Basic Science (29 credits)
CH 221 (5)_____
CH 222 (5)_____
CH 223 (5)_____
PH 211 (4)_____
PH 212 (4)_____
PH 213 (4)_____
Z (341,342 or 343)(2)_____ OR
MB 230 (4)_____

Advanced Biosciences (22 credits)
BB 450 (4)_____
BB 451 (3)_____
BB 493 (3)_____
BB 494 (3)_____
BIOE 340 (3)_____
Z 331 (3)_____
Z 333 (3)_____

Advanced Chemistry (8 credits)
_____( )_____
_____( )_____
_____( )_____
CH 331-CH 332 or CH 334-CH 336

Communication Skills (6 credits)
WR 121 (3)_____
WR 327 (3)_____

Communication Skills – Restricted Elective (3 credits)
COMM 111/114(3)_____
( )_____

Humanities and Social Sciences (21 credits)
Perspectives
Cultural Diversity ( )_____
Literature & Arts ( )_____
Soc. Proc. & Inst ( )_____
Western Culture ( )_____
Diff., Power, Disc. ( )_____
(Choose from selected courses)

Synthesis
Cont. Global Issues ( )_____
Sci., Tech. & Soc. ( )_____

The program is rigorous, but does provide some flexibility. In particular, the bioengineering curriculum was designed such that transfer between departments within the College of Engineering during the first two years (the "pre-engineering program") can be made with minimal loss of time. This is true of all undergraduate degree programs in the College of Engineering at OSU. In addition, many students find they can tailor their programs to their own particular interests simply by judicious use of restricted elective credits, while others elect to take additional credit hours to fulfill requirements of a second degree or minor.

MECOP

Last year was the first that Bioengineering students participated in the Multiple Engineering Co-operative Program. The number of participating students is expected to grow as industrial partners are identified and recruited. Table 2 provides an example coursework flow sheet that could be followed by students participating in MECOP.

Example coursework flow sheet followed by students participating in MECOP

	Fall	**Winter**	**Spring**
Third year of study	BB450 CHE 331 CHE 311 ENGR 407 BIOE 320	BB 451 CHE 332 WR 327	INTERNSHIP
Fourth year of study	BB 493 BIOE 414 BIOE 457 BIOE 462 ENGR 407	BB 494 BIOE 415	BIOE 340 BIOE 390 CHE 333
Fifth year of study	INTERNSHIP	BIOE 470	BIOE 420 BIOE 490