



Bioengineering MS Program Handbook 2023-2024



Oregon State
University



UNIVERSITY OF
OREGON

University of Oregon (UO)/Oregon State University (OSU)

Joint MS Program

PROGRAM OVERVIEW

The UO/OSU Joint MS program provides an unrivaled research and training environment that will prepare you to excel in private, government and academic sectors through a combination of technical, innovation, entrepreneurial and professional training. You will draw on the combined strengths of both institutions to tackle the complex, interdisciplinary research challenges in bioengineering and accelerate your progress toward successful careers. Further, you will gain real-world experience in multi-site collaboration that will be a hallmark of both academic and private sector research for decades to come. Training in innovation, entrepreneurship, communication and teamwork is threaded throughout your coursework and research experience to accelerate your progress toward your degree and career.

The joint graduate program offers you many benefits relative to programs sited on a single campus. These benefits include:

1. Enhanced education by tapping broader and deeper faculty expertise in the collaborative development and delivery of educational content;
2. Enhanced research collaborations between the two campuses that result from frequent, substantive faculty and student interactions;
3. Elevation of the Program's national brand, rankings and industry reputation by tapping a larger critical mass of faculty mentors and expertise;
4. Accelerated education and research progress by sharing complementary educational and research facilities; and
5. Expanded employment opportunities through a broader network of external relationships.

You will have complete access to courses, libraries, and other facilities at both OSU and UO, and upon selecting a permanent lab, you can assemble a thesis committee with appropriate faculty from both campuses. Upon graduation, you will receive a diploma issued by both institutions.

HOME CAMPUS

Your primary research home, and the place where you receive your student services, is your "home campus". At this time, MS students can only work with research advisors at OSU, so all MS students will have OSU as their home campus. The home campus provides an administrative home to students and manages all student experiences that must be tied to a location (e.g., health and student services, Graduate School forms and procedures, recreation center access, and athletic programs). All MS students in the Joint Program will have complete access to courses, research facilities, and libraries at both OSU and UO.

The administrative home for OSU home campus students is the School of Chemical Biological and Environmental Engineering (CBEE). Students are encouraged to contact the CBEE graduate program coordinator Kimberly Compton (kimberly.compton@oregonstate.edu) if they have any questions.

For other regulations relevant to OSU graduate students, see the OSU Graduate School Catalog (<https://catalog.oregonstate.edu/college-departments/graduate-school/#policiestext>).

COURSEWORK REQUIREMENTS

RECOMMENDED PREREQUISITE COURSEWORK

The following is recommended prerequisite coursework to prepare you to be successful in the Bioengineering Graduate Program.

Students with a B.S. degree in a non-engineering field are strongly encouraged to take the following courses prior to enrolling in the BIOE core courses:

- Math through Differential Equations
- One year of Physics
- A course on computer programming (e.g., Python)

REQUIRED COURSEWORK

MS students must take a total of 45 graduate credits and 12 of those credits must be thesis credits (BIOE 503). No more than 6 credits of blanket-numbered courses, other than thesis, may be counted toward the 45-credit minimum (blanket courses are courses with a zero as the second number, e.g., CBEE 507). At least half of the credits must come from graduate stand-alone courses. Students must take the BIOE core, professional development courses, research seminar and electives, as detailed below.

BIOE Core Courses:

All BIOE graduate students are required to take the following BIOE core courses:

BIOE 511: Cellular and Molecular Bioengineering (3 credits)

BIOE 512: Modeling of Physiological Systems (4 credits)

BIOE 513: Drug and Medical Device Regulation (3 credits)

BIOE 614 (offered remotely via UO): Technology Ventures: From Concept to Commercialization (3 credits)

Professional Development:

All newly enrolled students are required to take the full professional development series, CBEE 507 Professional Development, during their first year (3 total credits). The professional

development series is intended to develop your understanding of the profession, to introduce the research activities that take place in the School, and to develop professional skills including literature searching and citations, communication skills, ethics, and navigating graduate school.

Research Seminar:

Research seminars give students the opportunity for broad exposure to new research in bioengineering. In year two and beyond, all enrolled students holding a GRA/GTA position are required to register for CBEE 507 Seminar: Presentation, all terms(F/W/Sp). In addition, students are encouraged to attend the Oregon Bioengineering Symposium each fall.

Elective Course Selection:

At least 14 credits of elective courses are required. Electives must be non-blanket courses. Elective courses should be selected in consultation with your faculty advisor. Consideration should be given to your research area, your background, and achieving a balance between breadth and depth. Typically, students choose a range of courses in each of the following categories: engineering fundamentals, mathematics and statistics, biomedical science, and bioengineering. Some representative OSU courses in each of these categories are provided below. (This is a non-exhaustive list.) Students can also take elective courses at the UO.

Bioengineering:

<i>Course number</i>	<i>Course title</i>	<i>Credit hours</i>
BIOE 545	Surface analysis	3
BIOE 557	Bioreactors	3
BIOE 562	Bioseparations	3
ECE 599	Bioelectronic Systems and Devices	3
ECE 599	Biosensors and Medical Devices	3
CS 546	Networks in Computational Biology	3
IE 545	Human Factors Engineering	4
ROB 567	Human-Robot Interaction	4
ROB 562	Human Control Systems	4
KIN 525	Biomechanics of Musculoskeletal Injury	3
H 594	Applied Ergonomics	3
ME 513	Bio-Inspired Design	4
NSE 583	Radiation Biology	3

Biomedical Sciences:

<i>Course number</i>	<i>Course title</i>	<i>Credit hours</i>
VMB 521	Animal Models	3
VMB 652	Cancer Systems Biology	3
VMB 670	Introduction to Systems Biology	2
VMB 671	Molecular Tools	3
VMB 672	Molecular Approach to Cancer	1
VMB 673	Comparative Immunology	3
VMB 674	Vaccines and New Therapies	3
BB 585	Applied Bioinformatics	3
BB 586	Advanced Molecular Genetics	3
BB 590	Biochem 1: Structure & Function	3

BB 591	Biochem 2: Metabolism	3
BB 592	Biochem 3: Genetic Biochem	3
PHAR 525	Foundations of Drug Action I	3
PHAR 537	Bioorganic Chemistry	3
PHAR 547	Antibiotics and Infectious Disease	3
PHAR 548	Drug Actions in Immunology	3
PHAR 563	Cancer and Chemoprevention	2
PHAR 572	Applied Biopharmaceutics & Pharma	3
PHAR 574	Nanomedicine	3
PHAR 591	Pharmacology I	5
PHAR 594	Advances in Manipulating the Human Genome	3

Mathematics and Statistics:

<i>Course number</i>	<i>Course title</i>	<i>Credit hours</i>
ST 515	Design and Analysis of Planned Experiments	3
ST 592	Statistical Methods for Genomics Research	3
MTH 528	Stochastic Elements in Mathematical Biology	3
ME 526	Numerical Methods for Engineering Analysis	3
VMB 631	Mathematical Modeling of Biological Systems	3

Engineering Fundamentals:

<i>Course number</i>	<i>Course title</i>	<i>Credit hours</i>
ECE 564	Digital Signal Processing	4
ME 546	Convection Heat Transfer	3
ME 565	Incompressible Fluid Mechanics	3
CHE 520	Mass Transfer	4
CHE 537	Chemical Engineering Thermodynamics	4

Program of Study:

A program of study form must be approved by the student's committee and filed with the graduate school. The program of study defines the student's path to completion of coursework, and, once approved, it becomes the obligation of the student to complete the requirements as formulated. The program of study must be submitted no later than 15 weeks prior to the defense. Students are encouraged to complete the program of study early so they can get input from their committee. Changes in the program may be made by submitting a [Petition for Change of Program form](#) available in the Graduate School.

Transfer Credit:

Eligible graduate coursework completed previously can be transferred for credit towards the MS degree with the consent of the student's committee. Completion of the [Transfer Credit Request Form](#) is required if these credits were obtained outside of OSU.

ADVISOR SELECTION

Students entering the program on a teaching assistantship in the School of CBEE typically do research rotations and should select a research advisor during their first term at OSU. With

assistance from CBEE, students will identify and contact faculty members to set up a meeting to discuss research opportunities. In addition to meeting with faculty, it can also be helpful to meet with graduate students, attend lab meetings and visit the lab. At the end of the term, students will submit an Advisor Selection Form listing their top three choices for preferred advisors. The selection process will be finalized by the start of the next term. The student must sign a “letter of intent” to work with the specific advisor. This agreement is binding except in extraordinary circumstances. If a student believes a change of advisor is warranted they are encouraged to talk with the Graduate Program Coordinator.

COMMITTEE

The principal authority over a student's program resides with the student's Master's Committee. This committee is responsible for assuring that University and School requirements are satisfied, and administering the final oral examination. The committee is typically formed during spring term of the first year.

The committee consists of at least 4 members:

- the student's research advisor;
- an additional BIOE faculty member from OSU or UO;
- the student's minor professor, or if no minor is selected, the committee member may be from graduate faculty at-large at OSU or UO; and
- one Graduate Council Representative (GCR). The role of the GCR is to provide outside advocacy for the student, and they may come from any discipline outside of BIOE.

The committee is originally formed, with approval from the research advisor, at the student's invitation. The Graduate Council Representative is selected from a list generated by the [online GCR list generation tool](#). The GCR is a permanent member of the committee and *must* attend all committee meetings, including the program of study committee meeting, and the final examination (thesis defense).

EXPECTATIONS FOR RESEARCH DISSEMINATION

Dissemination of research findings is vital to the success of our graduates and the reputation of our graduate program. Research can be disseminated in various ways, including presentations at scientific conferences, peer-reviewed publications and patents. It is generally on the basis of these presentations and publications that the quality and impact of one's research endeavors is assessed and potential for future success evaluated. Stated another way, simply completing a MS thesis is generally not sufficient for attainment of the career goals of students and faculty.

In general, MS students give at least one presentation and publish one manuscript on the basis of their research. Students will have ample opportunity to present their work and hone their scientific communication skills. In particular, students are encouraged to give an oral presentation during CBEE seminar, and to present a poster at the CBEE open house, which takes place each fall. In addition, students are encouraged to present their work at the Oregon Bioengineering Symposium, which is a one-day conference that takes place each fall. Specific

expectations for research dissemination, including guidelines and timelines, are matters to be arranged between students and their faculty advisors.

MS THESIS & FINAL ORAL EXAMINATION

All MS students must submit a thesis embodying the results of research and presenting evidence of originality and ability in independent investigation. The thesis must constitute a valid contribution to knowledge in the field of study and must be based on the candidate's own investigation, including one or more of the following elements:

- Contribution to theory,
- Development of a new method or technology,
- Generation of new scientific data that clearly advances the science, and
- Development and/or novel implementation of a numerical model.

The thesis must reflect a mastery of the literature of the subject and be written in scientific format. Thesis guidelines are available at <http://gradschool.oregonstate.edu/success/thesis-guide>. We recommend that students use a "manuscript-based" thesis format, in which published or draft publications are bundled into a single thesis document.

The results from studies conducted using human subjects without obtaining Institutional Review Board approval shall not be used to satisfy master's thesis requirements. For more information, please send an email to irb@oregonstate.edu or visit the IRB website at <http://oregonstate.edu/research/irb/>.

After completion of or while concurrently registered for all work required by the program, the student must pass a final oral examination. The final oral examination **must be scheduled in the Graduate School not less than two weeks prior** to the date of the examination. The final oral examination should be scheduled for at least two hours. The Graduate Program Coordinator must also be notified for announcement in the School of CBEE no less than two weeks prior to the examination date.

The initial portion of the final oral examination is open to all interested persons. After the open portion of the exam, the examining committee excludes all other persons and continues with the examination of the candidate's knowledge of his or her field. The committee then votes on whether or not the student should pass. If more than one negative vote is recorded by the examining committee, the candidate has failed the examination. **Only one re-examination is permitted.**

When scheduling their final oral examinations, MS students are **required to submit** the pretext pages of their thesis to the Graduate School **at least two weeks prior to the final oral examination**. Pretext pages include the abstract, copyright (optional), title page, approval page, acknowledgment page, contribution of authors, table of contents, list of figures, tables, appendices, dedication (optional), and preface (optional). It is expected that students will

distribute examination copies of their thesis to all committee members, including the Graduate Council representative, at least two weeks prior to the student's final oral examination.

Within six weeks after the final oral examination or before the first day of the following term, whichever comes first, students must upload one PDF copy of the thesis, without signatures, electronically to ScholarsArchive and submit the signed ETD submission approval form with a copy of the title page to the Graduate School. Signatures on the ETD submission approval form can be electronic, signed, scanned and emailed or faxed. If final submission occurs after the initial six-week period, the student may be subject to re-examination. Please refer to the Graduate School's website for complete details.

Within **six weeks** of the final oral examination, one printed copy your thesis must be submitted to the School of CBEE main office for binding and archiving in the CBEE thesis library.

TIMELINE AND CHECKLIST

On the following page is a brief list of the steps required to obtain the MS degree. You should also become familiar with the specific and detailed information contained in the Graduate School Catalog as well as School requirements.

PROCEDURES FOR MS STUDENTS			
Check Box	Item #	Step	Timing
	1	Choose a major professor and a general thesis topic	By the end of your first term
	2	Appoint Masters Committee with approval of your major professor	By the end of your second term
	3	Generate Grad Council Rep (GCR) list ; and contact those people until you find someone willing to serve as your GCR	
	4	File a Masters Program of Study form	
	5	Read the Thesis Guide on the Grad School's website	Prior to starting your thesis
	6	Notify your major professor and committee of your intended graduation term	AT LEAST 1 term before your intended graduation term
	7	Compare Program form and transcripts for consistency	
	8	File Petition to Change Program form if needed.	
	9	Confirm submission of your approved Program of Study with Graduate School	15 weeks prior to final oral examination
	10	File a Diploma Application	
	11	Review rubric used for evaluating final exams	
	12	Complete final draft of your thesis, and submit it to your major professor for review and approval	By the start of your last term
	13	Decide on a day and time (at least 2 hours) with all Committee members (including Grad Council Rep)	AT LEAST 2 weeks prior to final oral examination
	14	Reserve a room with CBEE Office Coordinator	

	15	Fill out Exam Scheduling Form	
	16	Submit thesis pretext pages to the Graduate School	
	17	Submit a final draft of the thesis to all committee members (with advisor's approval)	
	18	Submit final oral examination appointment to Graduate Program Coordinator for announcement circulation	
	19	Remind (e-mail) Committee of the final oral examination	2 days prior to final oral examination
	20	Final oral examination	
	21	Print Electronic Thesis and Dissertation Form , obtain signature, and submit final thesis paperwork (See Submission Instructions)	Within 6 weeks of the exam or by the last day of the current term, whichever is first; if you miss the deadline, you may be required to register for an additional 3 credits.
	22	Print copy of thesis for School binding; submit to CBEE Office Coordinator.	
	23	Complete Graduate School Exit Survey (this will be emailed to you)	A month after graduation

NOTES ABOUT THE CHECKSHEET

- Although it is not included in the checklist, dissemination of research findings is essential and is expected to occur throughout your time in the program. The timing of research presentations and manuscript preparation will depend on your research progress and should be discussed with your faculty advisor.
- Give yourself and your committee members a lot of time to plan for the defense date. Sometimes committee members will be on sabbatical leave during the term in which you plan to defend. You should check with your committee members about such leaves far in advance to better plan, especially if you need to change a committee member for any reason. Note that your GCR must attend all meetings and examinations during your degree program.
- The Diploma Application must be filed no later than week two of the term in which you defend. However, completion of the form a term or two early is OK. If you need to change your end term after you file a Diploma Application, simply fill out the application again.
- When you confirm your defense exam date with the Graduate School, you are initiating their final audit of your transcript and making sure your exam is on their calendar. If they are not aware of your defense date, even if you filled out all the paperwork, you will not be allowed to defend and will have to reschedule.

CURRICULUM CHART FOR BIOENGINEERING MS STUDENTS

						Total Credits
Year 1	Fall	CBEE 507 Grad Seminar Prof. Dev. 1 cr	BIOE 511 Cell & Molecular BioE 3 cr	BIOE 512 Modeling of Phys Systems 4 cr	Grad Minor or Elective 3-4 cr	12
	Winter	CBEE 507 Grad Seminar Prof. Dev. 1 cr	BIOE 513 Drug & Med Device Regs in Tech Dev 3 cr	Grad Minor or Elective 3-4 cr	BIOE 503 MS Thesis Variable 1-12 cr	12
	Spring	CBEE 507 Grad Seminar Prof. Dev. 1 cr	BIOE 614 Tech Ventures: Concept to Commercialization 3 cr	Grad Minor or Elective 3-4 cr	BIOE 503 MS Thesis Variable 1-12 cr	12
Year 2	Fall	CBEE 507 Grad Seminar Presentation 1 cr	Grad Minor or Elective 3-4 cr	BIOE 503 MS Thesis Variable 1-12 cr		12
	Winter	CBEE 507 Grad Seminar Presentation 1 cr	Grad Minor or Elective 3-4 cr	BIOE 503 MS Thesis Variable 1-12 cr		12
	Spring	CBEE 507 Grad Seminar Presentation 1 cr	BIOE 503 MS Thesis Variable 1-12 cr			12

BIOE core (13 cr): BIOE 511, BIOE 512, BIOE 513, BIOE 614. BIOE 614 is offered remotely through UO.

Professional development (3 cr): CBEE 507, Seminar Professional Development is required for 3 terms (F/W/Sp).

Research seminar: Students are requested to enroll in CBEE 507, Seminar Presentations, each term after the 1st year.

M.S. Thesis (12 cr): variable credits, thesis credits can go over 12 units total to meet GTA/GRA requirements

Graduate Elective (14+ cr): Any graduate-level course, typically 4-5 courses. These are the most flexible credits. A graduate minor typically requires 15 credits of courses from the minor field. Students should consult with their research advisor about elective courses.

45 Total Credits required

Note: the completion timeline can vary and depends on how long it takes for successful completion of the MS research project and thesis.

PROGRAM OF STUDY EXAMPLE



Oregon State University
Graduate School

MASTERS

Check One	<input type="checkbox"/> EdM	<input type="checkbox"/> MA	<input type="checkbox"/> MAPE	<input type="checkbox"/> MATRN	<input type="checkbox"/> MCoun	<input type="checkbox"/> MEng	<input type="checkbox"/> MF	<input type="checkbox"/> MFA	<input type="checkbox"/> MHP	<input type="checkbox"/> MPP	<input checked="" type="checkbox"/> MS	<input type="checkbox"/> PSM
Last Name (Family)		First Name		Middle Init.		(Former)						
Day Phone #		ID#		Email Address								
Degree Now Held		When/Where Rcvd										

Academic Unit	
Major	
Minor <input type="checkbox"/> or Option <input type="checkbox"/>	
Minor <input type="checkbox"/> or Option <input type="checkbox"/>	

Check One	<input type="checkbox"/> Non-Thesis	<input checked="" type="checkbox"/> Thesis
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CAPSTONE						
Transfer Symbol	G*	Thesis (6-12 credits) If applicable	Course		Cr.	Gr.
			Dept.	No.		
		Thesis	BIOE	503	12	
Transfer Symbol	G*	Non-Thesis Project, Research or PSM Internship (3-6 credits) If applicable	Course		Cr.	Gr.
			Dept.	No.		
				501		
				505		
				506		
				510		
Total					12	

Transfer Symbol	G*	Title of Major Courses	Course		Cr.	Gr.
			Dept.	No.		
	G	Cell & Molec BioE	BIOE	511	3	
		Bioconjugation	BIOE	540	3	
		SocJus, Ethics, Eng	BIOE	520	3	
	G	Chm Eng Analysis	CHE	525	4	
	G	Modeling Phys Syst	BIOE	512	4	
	G	Drug & Med Dev Reg	BIOE	513	2	
	G	Bicelc Sys & Device	ECE	599	4	
	G	Seminar Prof Dev	CBEE	507	3	
		Bioreactors	BIOE	557	3	
	G	Fluid Flow	CHE	514	4	
Total					33	

If additional lines are needed, use a second form

SUPPORTIVE REQUISITES

MA ONLY: Foreign language requirements vary among academic units.

Languages	
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Master's students are expected to "Be able to conduct scholarly or professional activities in an ethical manner". Indicate the training you have completed or will complete to meet this learning outcome. See page 2 of this form for more information.

Ethical Research Training	CITI Responsible Conduct of Research
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SFM ONLY (MF, MS & PhD): See SFM Advising Guide

Communication Training	
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a. Total Major Hours	
b. Total First Minor or Option Hours	
c. Total Blanket Hour Credits	3
d. Total 4XX/5XX Program Credits	9
e. Total Graduate Standalone Credits	36
TOTAL CREDITS ON PROGRAM (d+e)	45

*Mark courses that will be graduate standalone with the letter "G" in this column.

Transfer Symbol	G*	Title of Minor or Option Courses	Course		Cr.	Gr.
			Dept.	No.		
Total						

If additional lines are needed, use a second form

Transfer Symbol	G*	Title of Minor or Option Courses	Course		Cr.	Gr.
			Dept.	No.		
Total						

If additional lines are needed, use a second form

Transfer courses indicated above:

Transfer Symbol	University
T1	
T2	
T3	

Scoring Guide (Rubric) for Graduate Learning Outcome Assessment
M.S. THESIS and FINAL ORAL EXAM in BIOENGINEERING

Candidate Name: _____ Date: _____

Title of Examination Document: _____

Name and Signature of the Examining Committee Member: _____

Criteria	Unsatisfactory	Satisfactory	Exemplary
1a. Research Hypothesis and Objectives	Research problem not clearly stated, or statement not carefully considered and hypothesis driven; Research plan to investigate solution to the defined problem is not fully considered; Measurable technical outcomes not described.	Research problem clearly stated and hypotheses behind research activities identified; Research plan to investigate solution to the defined problem adequately considered; Measurable technical outcomes described.	Research problem fully considered and hypotheses behind all research questions clearly enunciated with broader impacts in the field identified; Research plan to investigate solution to the defined problem fully considered; Measurable technical outcomes described and significance of likely measurements discussed.
1b. Literature Review	The review belies a summative approach, with information presented in a disconnected, disjointed manner and not clearly tied to the research; widely known technical references clearly missing or not germane to the topic at hand.	The information is organized by themes that are related; Ideas are explored as the writing attempts to take an expert approach. However, some themes may be disconnected; some references known to experts in the field may be missing.	The information is clearly synthesized into themes. The writing demonstrates an expert approach by illustrating the relationship between themes, concepts, and ideas reported in the literature, and links these themes to the focus of the research. References are complete.
2. Ability to Demonstrate a Creative Solution to the Problem	Proposed concept is well known, previously described in technical literature, or is impossible/illogical	Proposed work is original and possible but derivative/incremental in nature	Proposed work is original, practical and demonstrates a novel approach.
3. Application of Science and Engineering Fundamentals	Science/Engineering principles underlying Research Hypothesis and Objectives not clearly identified. Lack of awareness of assumptions and limitations.	Science/Engineering principles underlying Research Hypothesis and Objectives identified and discussed. Major assumptions clearly stated.	Science/Engineering principles underlying Research Hypothesis and Objectives identified and discussed. Major assumptions clearly stated; as appropriate math models and associated predictions developed.
4a. Quality of Written Communication	Writing style is immature. Profuse grammatical errors, poor sentence construction and/or poor document structuring make it laborious to read.	Writing style is academic and flows by presenting information in a concise manner. There are only minor grammatical and spelling errors.	Writing style is scholarly and flows naturally, presenting information in a clear and precise manner. Voice is active and devoid of bias. No grammar or spelling errors.
4b. Quality of Oral Communication	Disorganized presentation with low original content; Excessively poor communication skills; Answers to questions show weakness in depth of knowledge in subject matter and/or poor critical thinking skills.	Adequately organized presentation where concepts flow logically; Adequate communication skills; Answers show adequate knowledge in subject area and adequate critical thinking skills	Highly engaging conference quality presentation; Excellent communication skills; Answers show superior knowledge in subject area and well developed critical thinking skills.

During the examination process I did not perceive any lapses in ethical performance and/or reporting of research: _____

Examiner: Please use the reverse of this form for written commentary as needed.

GRADUATE LEARNING OUTCOMES FOR BIOENGINEERING MS STUDENTS

Outcome 1: Scholarship

The student will be able to identify and conduct original research resulting in a significant contribution to knowledge in the fields spanned by Bioengineering and to effectively communicate this work to a technically literate audience.

This will be assessed using the M.S. Thesis and Final Oral Examination (“Defense”).

Outcome 2: Mastery of Subject Material

The student will be able to think critically, creatively and to address technical problems in the fields spanned by Bioengineering.

This will be assessed through satisfactory completion of the graduate program of study, as well as course summaries written by the instructors.

Outcome 3: Ethical Conduct

Students will be educated in ethical and responsible conduct in research and professional activities.

This will be assessed through satisfactory completion of the graduate seminar (BIOE 507), as well as ethical completion of the M.S. Thesis and Final Oral Examination.