

**Bioengineering
Ph.D. and M.S. DEGREE REQUIREMENTS**

Revised: *[Copied from CCGA proposal of 2018; current year: 2021]*

Graduate Council Approval:_____

Table of Contents

1. Introduction

- 1 Aims and Scope
- 1 Admissions Requirements
 - 1 Prerequisites
 - 1 Deficiencies
- 1 General Committees
 - 1 Executive Committee
 - 1 Admission Committee
 - 1 Education Policy Committee

2. Master's Degree Requirements

- 2 Degree Plan I- Thesis
 - 2 Program Learning Outcomes (PLOs)
 - 2 Course Requirements - Core and Electives
 - 2 Core Courses
 - 2 Elective Courses
 - 2 Summary
 - 2 Special Requirements
 - 2 Advancement to Candidacy
 - 2 Thesis Requirements
- 2 Degree Plan II- Non-thesis
 - 2 Program Learning Outcomes (PLOs)
 - 2 Course Requirements - Core and Electives
 - 2 Core Courses
 - 2 Elective Courses
 - 2 Summary
 - 2 Special Requirements
 - 2 Advancement to Candidacy
 - 2 Comprehensive Examination
 - 2 Timing
 - 2 Examination
 - 2 Outcome Advising Structure and Mentoring
 - 2 Advising Structure
 - 2 Evaluation of Student Progress

Bioengineering - Policies and Procedures

- 2.5 Committees
 - 2 Thesis Committee
 - 2 Comprehensive Examination Committee
 - 2 Other
- 2.6 Normative Time to Degree
- 2.7 Typical Timeline and Sequence of Events
- 2.8 Sources of funding

3. Doctoral Degree Requirements

- 3 Program Learning Outcomes (PLOs)
- 3 Course Requirements - Core and Electives
 - 3 Core Courses
 - 3 Elective Courses
 - 3 Summary
- 3 Special Requirements
- 3 Dissertation Plan
- 3 Advising Structure and Mentoring
 - 3 Advising Structure
 - 3 Evaluation of Student Progress
- 3 Committees
 - 3 Candidacy Committee
 - 3 Doctoral Committee
 - 3 Other
- 3 Advancement to Candidacy
- 3 Qualifying Examination Requirements
- 3 Dissertation Requirements
- 3 Normative Time to Degree
- 3 Typical Timeline and Sequence of Events
- 3 Sources of Funding
- 3 Leaving the Program Prior to Completion of the PhD Requirements.

4. General Information

- 4 PELP, In Absentia and Filing Fee Status

1. Introduction

1.1 Aims and Scope:

Bioengineering is an area of research that combines approaches and methodologies from multiple traditional disciplines, and which is now well established as a separate discipline and experiencing great growth worldwide with the continuous development of new technologies for the study, characterization and manipulation of biological systems from the molecular to the organismal levels. This Graduate Program offers a Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Bioengineering (BIOE).

At the master's level, the Bioengineering degree provides the disciplinary knowledge and research skills for students who are more industry- or professionally oriented, and wish to acquire technical skills and broad knowledge of Bioengineering for a career in a wide range of technologically leading industries including biotechnology, health sciences, pharmaceutical, agricultural, environmental and many other related fields. At the doctoral level, the Bioengineering degree provides deep disciplinary knowledge and independent research skills for students who are more interested in advanced careers in industry, federal research laboratories or academia. The Bioengineering graduate program has core and affiliate faculty members in the School of Engineering and in the School of Natural Sciences. The Bioengineering graduate program is administered through the recently created Bioengineering academic unit within the School of Engineering.

1.2 Admissions Requirements:

Applicants must meet the minimum requirements for admission to graduate study at University of California, Merced, described in the Section II of the Graduate Student Handbook. Admission into Bioengineering further requires adequate background in Chemical and Physical Sciences, which typically involve upper division classes in Thermodynamics, Kinetics, Transport, Molecular Spectroscopy, and Organic Chemistry; in Biological Sciences, which typically involve Biochemistry, Molecular and Cell Biology, and Genetics; and adequate Mathematics background (Linear Algebra, Differential Equations, Numerical Methods, etc.). A graduate student in Bioengineering can be granted conditional admission pending remedial classes that would allow the student to take graduate classes in the program. Academically qualified students may also be required to complete a telephone or in-person interview with one or more of the BIOE faculty members.

Prospective graduate students should submit the following materials

- The complete official application form;
- The application fee;
- All official university/college/junior college transcripts;
- [OPTIONAL] Official GRE score reports from the analytical writing, quantitative reasoning, and verbal reasoning.

Bioengineering - Policies and Procedures

- Three letters of recommendation from instructors or supervisors who can comment on the applicant's scholarly ability and promise as a researcher;
- Official score reports from the Test of English as a Foreign Language (TOEFL) or IELTS (International English Language Testing System), if the applicant spent the majority of their primary and secondary education in a nation/territory where English is not the primary language;
- Current curriculum vitae;
- Statement of Purpose;
- Personal History.

Admission decisions are made on a case-by case basis. Meeting some or all of these criteria does not guarantee admission, but merely eligibility.

1.3 General Committees:

- 1 **Executive Committee:** The Executive Committee (EC) will consist of a minimum of three members who will serve rotating terms of three years. The Program chair will serve as an *ex officio* member of the Committee. It will be the responsibility of the EC to prepare an annual slate of nominees that will be put before the membership for election to serve on the EC. Members can be re-elected and serve two consecutive three-year terms but must sit out one election cycle before running for a third term. The EC will make appointments to the standing committees from the membership of the Program. The EC shall, in consultation with the faculty, determine and implement policy for the good of the Program, establish and guide the educational requirements of the Program, and represent the interests of the Program to the University and other agencies. The EC will make appointments to the other committees and approve membership in the Bioengineering graduate program.
- 1 **Membership Committee:** The Membership Committee will be responsible for reviewing applications from faculty who wish to be part of the Program. In addition, the Committee will review the membership of the Program every four years. The Membership committee will recommend approval or denials for membership to the EC.
- 1 **Educational Policy Committee:** The Educational Policy Committee (EPC) is responsible for establishing and guiding the educational programs of the Program. The EPC will be formed by the Executive Committee and will conduct annual reviews of the programs. The EPC in consultation with the program faculty will determine changes in programmatic requirements of the Bioengineering graduate program.
- 1 **Admissions Committee:** The Admissions Committee is charged with the development of recruiting materials for the Program, reviewing applications for admissions, making recommendations for admissions to the Vice Provost and Dean of Graduate Education, exploring graduate student support mechanisms, and allocating intramural financial assistance.

2. Master's Degree Requirements

The Bioengineering program has established the following requirements for the M.S. degree. Each M.S. student must have a faculty advisor responsible for designing and

Bioengineering - Policies and Procedures

approving a plan of study detailing all classes to be taken. Two different tracks are recognized as described below. Students may switch from one M.S. plan to another with their faculty advisor's consent.

2.1 Degree Plan I- Thesis:

- Complete at least two semesters of full-time academic residence at UCM.
- Complete at least 24 units of letter-graded 200-series graduate level course work exclusive of credit given for thesis research and preparation (see Section 2.1.2).
- Maintain a cumulative GPA of at least 3.0.
- Complete at least 12 units of research.
- Prepare a written thesis describing relevant research in the field that is read and accepted by a thesis committee.
- Defend the M.S. thesis via oral presentation attended and approved by the committee.

2.1.1 Program Learning Outcomes (PLOs):

Graduates of the Bioengineering program at UC Merced will possess:

- 1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 3) An ability to communicate effectively with a range of audiences.
- 4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- 5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- 6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- 7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- 8) Experience in solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems.
- 9) Experience in analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes.

2.1.2 Course Requirements - Core and Electives (total 24 units):

2.1.2.1 Core Courses (total 9 units)

Course Number	Course Name	Units
---------------	-------------	-------

BIOE 210	Biological Thermodynamics, Kinetics and Transport	4
BIOE 215	Biological Imaging and Spectroscopy	4
BIOE 291	Bioengineering Seminar Series	1

- 2 **Elective Courses (15 units):** No other specific courses are uniformly required for all Bioengineering graduate students. Students should work with their advisors to determine which additional courses are best suited for their research areas and to satisfy the total unit requirements. Course selection should be discussed with advisors each year at the annual review meeting. This may include any letter-graded graduate level elective BIOE course (200 or higher) as well as graduate level courses in other areas with the consent of the advisor.
- 2 **Summary:** 9 units of core coursework, and 15 units of elective coursework are required for a total of 24 units. Students must enroll for 12 units per semester including research, academic and seminar units to be eligible for graduate student researcher and academic student employee appointments, and university-administered fellowships. Per UC regulations, ordinarily students shall not receive credits for more than 12 units of graduate-level (200) courses per semester.

2.1.3 Special Requirements: N/A

- 2 **Advancement to Candidacy:** Before advancing to candidacy for the Master's degree, a student must have satisfied all plan requirements set by the graduate program and must have maintained a minimum GPA of 3.0 or higher in all course work undertaken. Normally, students advance by the end of the third semester. The student must file the appropriate paperwork (Application for Advancement to Candidacy for the Master's Degree and Conflict of Interest Form) by the terms and deadlines specified in the Graduate Division website. Students must be advanced to candidacy prior to degree conferral.
- 2 **Thesis Requirements:** The student will prepare a written thesis under supervision of their faculty advisor until the work is judged by the advisor ready for review by the faculty committee. The student must provide a copy of the thesis to each member of the faculty committee and allow each committee member at least two weeks to read and comment on it. If one or more committee members believe that there are significant errors or shortcomings in the thesis or that the scope or nature of the work are not adequate, the student must address these shortcomings before scheduling a defense. Once the student and advisor are in agreement that the thesis is ready to be defended, the defense may be scheduled by the student in consultation with the committee. Once the date of the thesis defense is determined, this information must be reported to the Graduate Dean, and one copy of the thesis must be filed through

UC Merced's Electronic Thesis and Dissertation (ETD) website by the last day of the semester in which the degree is to be conferred.

The thesis defense consists of an open seminar followed by a closed-door examination by the thesis committee. During the examination, the student is expected to explain the significance of the research, justify the methods employed, and defend the conclusions reached.

At the conclusion of the examination, the committee shall vote on whether the thesis and the student's performance on the exam are of satisfactory quality to earn a University of California M.S. degree. The unanimous vote of pass by the committee members is required for a pass of the exam. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the thesis. In this case, the committee will select one member, normally the graduate research advisor, who will be responsible for approving the final version of the thesis that is submitted to the Graduate Division. All members of the thesis committee must sign the final thesis.

Should the Thesis Committee determine that the thesis is unacceptable, a recommendation to disqualify the student may be made to the Vice Provost and Dean of Graduate Education.

Detailed information and instructions on the submission and filing of the thesis is available in the UCM Thesis and Dissertation Manual. A schedule of dates for filing the thesis in final form are published on the Graduate Division website in the Dates and Deadlines section.

2.2 Degree Plan II- Non-thesis:

- Complete at least two semesters of full-time academic residence at UCM.
- Complete at least 30 units of letter-graded graduate course work.
- Maintain a cumulative GPA of at least 3.0
- Complete at least 6 units of research.
- Pass an oral comprehensive examination administered by the faculty committee.

2.2.1 Program Learning Outcomes (PLOs):

Graduates of the Bioengineering program at UC Merced will possess:

- 1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 3) An ability to communicate effectively with a range of audiences.
- 4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Bioengineering - Policies and Procedures

- 5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- 6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- 7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. Page 8
- 8) Experience in solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems.
- 9) Experience in analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes.

2.2.2 Course Requirements - Core and Electives (total 30 units)

2 Core Courses (total 9 units)

Course Number	Course Name	Units
BIOE 210	Biological Thermodynamics, Kinetics and Transport	4
BIOE 215	Biological Imaging and Spectroscopy	4
BIOE 291	Bioengineering Seminar Series	1

- 2 **Elective Courses (21 units):** No other specific courses are uniformly required for all Bioengineering graduate students. Students should work with their advisors to determine which additional courses are best suited for their research areas and to satisfy the total unit requirements. Course selection should be discussed with advisors each year at the annual review meeting. This may include any letter-graded graduate level elective BIOE course (200 or higher) as well as graduate level courses in other areas with the consent of the advisor.
- 2 **Summary:** 9 units of core coursework, 21 units of elective coursework, and 6 units of research are required for a total of 36 units. Students must enroll for 12 units per semester including research, academic and seminar units to be eligible for graduate student researcher and academic student employee appointments, and university-administered fellowships. Per UC regulations, ordinarily students shall not receive credits for more than 12 units of graduate-level (200) courses per semester.

2.2.3 Special Requirements: N/A

- 2 **Advancement to Candidacy:** Before advancing to candidacy for the Master's degree, a student must have satisfied all plan requirements set by the graduate program and must have maintained a minimum GPA of 3.0 or higher in all course work undertaken. Normally, students advance by the end of the third semester. The student must file the appropriate paperwork (Application for Advancement to Candidacy for the Master's Degree) by the terms and deadlines specified in the Graduate Division website. Students must be advanced to candidacy prior to degree conferral.

2.2.5 Comprehensive Examination:

- 2 **Timing:** Students may take the comprehensive examination once they have advanced to candidacy. However, it is important that this capstone requirement be completed at or near the end of the coursework for the Master's degree. For most students, the exam is taken at the end of fourth semester. Students must be registered or in current filing fee status at the time when they take the examination.
- 2 **Examination:** The M.S. comprehensive examination is a 2-hour oral test and the content of the exam represents a capstone requirement that integrates the intellectual substance of the program. The test will be given by three members of the Bioengineering faculty, with the possibility of one member being an invited faculty member from a related program, who will jointly determine the outcome.
- 2 **Outcome:** Examinations can result in either a pass, fail with an option to retake the examination upon faculty's recommendation, or fail without option to retake the examination. The results, as well as the procedures for repeating a failed examination, are described in Section VI. F of Graduate P&P Handbook. Within 30 days of the examination date, the chair of the committee must submit to the Graduate Group Chair or his/her designee and the school's graduate support staff the Examination Report conveying information about the student's performance on each of the components covered during the examination. The graduate support staff will then submit the Examination Report to the Graduate Division.

2.3. Professional Master Degree

Not applicable.

2.4. Advising Structure and Mentoring

- 2 **Advising Structure:** A graduate student is expected to have a faculty advisor at all times during their graduate studies.

The heart of the Bioengineering graduate program for Ph.D. and M.S. Plan I students is the completion of a piece of original scientific research leading to the preparation and defense of thesis. To this end, each student should discuss research interests and possible projects with faculty in the program as early as possible, and select a graduate research advisor early during the first year of study. Selection of a graduate research advisor must be approved by the Bioengineering graduate program and must occur before the student's faculty committee can be constituted. The student and the graduate research advisor together will develop a research topic, and research will normally occupy a majority of the student's time after the first year of residence. Interdisciplinary projects are highly encouraged, as are research collaborations with faculty or senior scientists outside UCM. However, the graduate research advisor must be a member of the Bioengineering program. Students will be assigned an initial advisor when they first enroll, unless the student has already chosen an advisor.

If there is a separation of advisor/advisee, the program chair will be the temporary advisor and the graduate has to find a new advisor in the following semester.

2.4.2 Evaluation of Student Progress

All students must schedule an annual review with their research advisor during which they evaluate the progress made during the prior year, discuss any areas that need improvement, identify upcoming milestones towards the degree objective, and outline plans for specific research objectives in the next year. The outcomes of these meetings are documented using the Annual Progress Form and Student Progress Review Form.

2.5. Master's Degree Committees:

2 **Thesis Committee:** M.S. thesis committees in the Bioengineering program typically consist of three members, although additional committee members are permitted if warranted by the student's research project. One is the student's graduate research advisor and the two or more others are UCM faculty members in the program (one of whom is appointed as Committee Chair). Under some circumstances one of the committee members can be a UCM faculty member from outside the program or a regular or adjunct faculty member from any UC campus or an individual from outside the University of California who has special expertise and qualifications. In this case, the graduate research advisor should submit a brief statement indicating the appointee's affiliation and title and how the prospective appointee has special expertise or qualifications that are not represented on the campus. In addition to the justification letter from the graduate advisor, a curriculum vitae and a letter from the proposed appointee indicating a willingness to serve must be submitted to the Chair of the Bioengineering graduate program for review. External committee members must also be approved by the Graduate Dean. Outside member participation is not required for the M.S. thesis committees.

All members of the committee must be in attendance (either in person or remotely) for the M.S. thesis defense. If a committee member's absence from campus for an extended period of time makes scheduling of examinations unreasonably difficult, the student may request that the committee be reconstituted. Reconstitution of the committee may also be justified by a substantial change in the student's thesis topic or may be required by the departure of a committee member from the university. When membership changes must be made, the graduate advisor in consultation with the student should recommend a new committee member, giving the reason for the change. The change must be reviewed and approved by the Chair of the BIOE graduate program and by the Graduate Dean.

The Chair of the committee shall always be a member of the Merced Division and of the Graduate Group supervising the master's program; no exceptions will be granted for this position. Detailed instructions are found in Graduate Policies and Procedures, Section VII. A.2.2, at the [Graduate Division Website](#).

2 Comprehensive Examination Committee: The comprehensive examination committee is created as described in section 2.5.1.

2.6 Normative Time to Degree: For students who are engaged in full-time study and making adequate progress, it is expected that they would advance to candidacy and complete the degree within two years. Extensions beyond these limits can be permitted by the Education Policy Committee.

2.7 Typical Timeline and Sequence of Events: The goals and needs of individual students vary considerably, and no single plan will accommodate all students. Therefore, the following program of study should be considered as a general guide only. In particular, the following example illustrates a 2-year program of study, which may not be appropriate for all students.

The general timeline for Master's Degree Plan I:

Year/Semester	Activities
Year 1 (Semesters 1,2)	Learn about research
	Take classes
Summer 1	Begin full-time research with faculty advisor
Year 2 (Semesters 3,4)	Continue full-time research with faculty advisor
	Assemble faculty committee
	Prepare manuscript(s) for publication
	Present work at scientific conference; network for career
	Defend and publish thesis

Example of Master's Degree Plan I:

Year	Fall Semester	Spring Semester
------	---------------	-----------------

Bioengineering - Policies and Procedures

1	BIOE 215: Biological Imaging and Spectroscopy (4) BIOE 260: Advanced Biomedical Imaging (3) BIOE 291: BIOE Seminar Series (1) BIOE 295: Graduate Research (4 units)	BIOE 210: Biothermodynamics, Kinetics and Biotransport (4) BIOE 205: Molecular and Cell Biophysics (4) BIOE 291: BIOE Seminar Series (1) BIOE 295: Graduate Research (3 units)
2	BIOE 240: Biomolecular Engineering (4) BIOE 295: Graduate Research (7) BIOE 291: BIOE Seminar Series (1)	BIOE 270: Human Physiology for engineering (4 units) BIOE 295: Graduate Research (8 units) Complete and defend M.S. thesis

The general timeline for Master's Degree Plan II:

Year/Semester	Activities
Year 1	Take classes
Year 2	Finish coursework and pass Comprehensive Exam

Example of Master's Degree Plan II:

Year	Fall Semester	Spring Semester
1	BIOE 215: Biological Imaging and Spectroscopy (4) BIOE 240: Biomolecular Engineering (4) BIOE 260: Advanced Biomedical Imaging (3) BIOE 291: BIOE Seminar Series (1)	BIOE 210: Biothermodynamics, Kinetics and Biotransport (4) BIOE 205: Molecular and Cell Biophysics (4) BIOE 270: Human Physiology for engineering (4 units)
2	CHEM 281: Molecular Dynamics and Biomolecular Simulation (3 units) QSB 252: Cancer Genetics and Tumor Biology (3) BIOE 291: BIOE Seminar Series (1) BIOE 295: Graduate Research (5)	QSB 285 Biostatistics (4) QSB 275 Epigenetics & Gene Expression (3) BIOE 295: Graduate Research (5) M.S. comprehensive exam

2 Sources of Funding: M.S. Plan I students are typically supported as graduate student researchers via a research grant by their faculty advisor or a student fellowship earned by the student. M.S. Plan II students typically pay their own way. In some cases, M.S. students may have an opportunity to be supported via a teaching assistantship, but this funding is preferentially offered to Ph.D. students.

3. Doctoral Degree Requirements

3.1 Program Learning Outcomes (PLOs):

Graduates of the Bioengineering program at UC Merced will possess:

Bioengineering - Policies and Procedures

- 1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. **Page 13**
- 2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 3) An ability to communicate effectively with a range of audiences.
- 4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- 5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- 6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- 7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- 8) Experience in solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems.
- 9) Experience in analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes.

3.2 Doctoral Degree Requirements

Students entering the program with an M.S. degree must:

- Complete at least four semesters of full-time academic residence at UCM.
- Complete at least 14 units of letter-graded graduate course work.
- Maintain a cumulative GPA of at least 3.0.
- Serve as a Teaching Assistant for at least one semester.
- Give one open technical seminar on campus or make a presentation at a professional conference.
- Pass a written Preliminary Examination to show mastery of fundamental bioengineering topics.
- Present a written thesis proposal and pass a Qualifying Examination in which the proposed research is presented to the dissertation committee.
- Present and successfully defend a doctoral dissertation containing an original contribution to knowledge in the field. Original contribution of knowledge to the field may be demonstrated by publication of all or part of the dissertation results in peer-reviewed journals.

M.S. and Ph.D.

Students whose degree objective is a Ph.D. but who wish to also receive an M.S. from UCM must complete all requirements for an M.S. degree either Plan I or II in addition to the requirements for the Post M.S. degree described above.

Direct Ph.D.

Students who directly enter the Ph.D. program with a bachelor's degree and do not intend to pursue an M.S. degree en route to the Ph.D. must:

- Complete at least six semesters of full-time academic residence at UCM. Page 14
- Complete at least 24 units of letter-graded graduate course work.
- Maintain a cumulative GPA of at least 3.0.
- Serve as a Teaching Assistant for at least one semester.

Give one open technical seminar on campus or make a presentation at a professional conference.

Pass a written Preliminary Examination to show mastery of fundamental bioengineering topics.

Present a written thesis proposal and pass a Qualifying Examination in which the proposed research is presented to the dissertation committee.

Present and successfully defend a doctoral dissertation containing an original contribution to knowledge in the field. Original contribution of knowledge to the field may be demonstrated by publication of all or part of the dissertation results in peer-reviewed journals.

3.2.1. Core Courses (total 10 units)

Course Number	Course Name	Units
BIOE 210	Biological thermodynamics, Kinetics and Transport	4
BIOE 215	Biological Imaging and Spectroscopy	4
BIOE 291	Bioengineering Seminar Series	2

Note: BIOE 291 is 1 unit per semester and should be registered in two semesters for two units.

3.2.2. Elective Courses (minimum of 14 units without approved M.S. degree; and less with substitute units from an approved M.S. degree)

For a student entering with an M.S. degree, the advisor will suggest which courses the student has taken in their M.S. program can be accepted as substitutes for some or all of the elective courses in the Ph.D. program. The Executive Committee and program chair will review and approve the M.S. degree if suitably relevant and rigorous, and approve the specific substitute courses and how many units they will be considered to satisfy of the Ph.D. elective requirement of 14 units.

No other specific courses are uniformly required for all Bioengineering graduate students. Students should work with their advisors to determine which additional

courses are best suited for their research areas and to satisfy the total unit requirements. Course selection should be discussed with advisors each year at the annual review meeting. This may include any letter-graded graduate level elective BIOE course (200 or higher) as well as graduate level courses in other areas with the consent of the advisor.

- 3 **Summary:** A minimum of 14 units of graduate coursework for students with a master's degree and a minimum of 24 units of graduate coursework for direct PhD student. Students without a prior M.S. degree or who have not previously earned a Master's degree in Bioengineering or similar discipline wanting an additional M.S. degree, have the option to get a "Master's along the way." Electives are chosen with the approval of the graduate advisor. Students must enroll for 12 units per semester including research, academic, and seminar units to be eligible for graduate student researcher and academic student employee appointments, and university-administered fellowships. Per UC regulations, ordinarily students shall not receive credits for more than 12 units of graduate-level (200) courses per semester.
- 3 **Special Requirements:** Bioengineering requires all graduate students pursuing the Ph.D. to serve as a Teaching Assistant for at least one class, and to give at least one open technical seminar or a presentation at a professional conference during their residence in the graduate program. The presentation may be part of a regular seminar series or as a special seminar.
- 3 **Dissertation Plan:** In accordance with University of California policy, a minimum of four semesters in academic residence is required prior to awarding the Ph.D. Typically, a longer period of study, four to six years, is required for completion of all degree requirements. All graduate students are considered resident graduates not candidates for a degree, unless admitted to candidacy after completion of all candidacy requirements and approval by the Graduate Division after formal application. A student advances to candidacy for the Ph.D. upon successfully demonstrating a high level of scholarship at the Ph.D. level, and upon completing all preparatory work and demonstrating readiness to proceed to the dissertation phase. Section 3.9 provides more detailed information on the dissertation phase.

3.5. Advising Structure and Mentoring:

- 3 **Advising Structure:** A graduate student is expected to have a faculty advisor at all times during their graduate studies.

The heart of the Bioengineering graduate program for Ph.D. and M.S. Plan I students is the completion of a piece of original scientific research leading to the preparation and defense of thesis. To this end, each student should discuss research interests and possible projects with faculty in the program as early as possible, and select a graduate research advisor early during the first year of study. Selection of a graduate research advisor must be approved by the Bioengineering graduate program and must occur before the student's faculty committee can be constituted. The student and the graduate research advisor together will develop a research topic, and research will normally

occupy a majority of the student's time after the first year of residence. Interdisciplinary projects are highly encouraged, as are research collaborations with faculty or senior scientists outside UCM. However, the graduate research advisor must be a member of the Bioengineering program. Students will be assigned an initial advisor when they first enroll, unless the student has already chosen an advisor.

3.5.2 Evaluation of Student Progress

All students must schedule an annual review with their research advisor during which they evaluate the progress made during the prior year, discuss any areas that need improvement, identify upcoming milestones towards the degree objective, and outline plans for specific research objectives in the next year. The outcomes of these meetings are documented using the Annual Progress Form and Student Progress Review Form.

3.6. Doctoral Degree Committees:

3.6.1 Candidacy Committee: The Candidacy Committee is charged with determining the fitness of the student to proceed with the doctoral dissertation through a formal Qualifying Examination. The Candidacy Committee is comprised of three or more faculty who are voting members of the University of California Academic Senate. Nominations of non-faculty members (i.e. Professional Researchers or faculty members from other universities) will be considered on an exception-only basis. For further details on the appointment process, see the Graduate Policies and Procedures Handbook on Doctoral Candidacy Committee. One member is the student's graduate research advisor and the two or more others are UCM faculty members in the program (one of whom is appointed as Committee Chair). Under some circumstances one of the committee members can be a UCM faculty member from outside the program or a regular or adjunct faculty member from any UC campus or an individual from outside the University of California who has special expertise and qualifications. In this case, the graduate research advisor should submit a brief statement indicating the appointee's affiliation and title and how the prospective appointee has special expertise or qualifications that are not represented on the campus. In addition to the justification letter from the graduate advisor, a curriculum vita and a letter from the proposed appointee indicating a willingness to serve must be submitted to the Chair of the Bioengineering graduate program for review. External committee members must also be approved by the Graduate Dean. Outside member participation is not required for either the M.S. thesis or Ph.D. dissertation committees. However, participation of an external (fourth) member in the Ph.D. dissertation committee is strongly encouraged. All members of the committee must be in attendance (either in person or remotely) for the Ph.D. dissertation defense. If a committee member's absence from campus for an extended period of time makes scheduling of examinations unreasonably difficult, the student may request that the committee be reconstituted. Reconstitution of the

committee may also be justified by a substantial change in the student's thesis topic or may be required by the departure of a committee member from the university. When membership changes must be made, the graduate advisor in consultation with the student should recommend a new committee member, giving the reason for the change. The change must be reviewed and approved by the Chair of the BIOE graduate program and by the Graduate Dean.

- 3 **Doctoral Committee:** The Doctoral Committee shall supervise the preparation and completion of the dissertation and the final examination. The Doctoral Committee is created as described in section 3.6.1. Member nominations are submitted to the Graduate Division for formal appointment in accordance with Graduate Council policy.

3.7. Advancement to Candidacy:

Upon successful completion of the Research Proposal and Qualifying Examination the student will fill out and submit an application for advancement to candidacy according to the terms and dates specified in the Graduate Division website. After the application is signed by the graduate research advisor and graduate program chair, the student pays a candidacy fee and submits the form to the Graduate Division. Upon advancement to candidacy for the degree, the faculty committee is then charged to guide the student in research and in the preparation of the dissertation. Students must be advanced to candidacy prior to degree conferral.

3.8. Qualifying Examination Requirements:

After the Preliminary Exam is passed and all the course work is satisfactorily completed and before the end of the fifth semester, Ph.D. candidates are required to write a Research Proposal and then take and pass a Qualifying Examination.

The student will provide to the dissertation committee a written research proposal that describes his or her research topic, summarizes progress to date, and outlines what he or she proposes to do, why it is relevant, and what will be learned. The dissertation committee will receive this document no later than 2 weeks before the scheduled Qualifying Examination. The Qualifying Examination will include two parts: a presentation of the proposal of the research for the dissertation, and a structured oral examination on graduate course materials and topics related to the proposed research. The student must be registered in the semester of the examination. The qualifying exam should be taken by the fourth semester and no later than the end of the sixth semester after admission to the Ph.D. program.

Before voting upon its recommendation for or against candidacy, the Candidacy Committee, as a whole, shall meet with the student, and any member of the committee will have the right to pose appropriate questions to the student. The committee must conclude its examination when convened with the student present. The committee, having reached a unanimous decision, shall inform the student of its decision to:

Pass -- A student has passed when the Candidacy Committee unanimously votes that the student passed the entire examination with scholarship that is at least acceptable. The committee must report to the Graduate Council via the Vice Provost and Dean of Graduate Education within 30 days. If agreed unanimously by the committee the student may be allowed to make minor modifications prior to submitting the results of the examination.

Fail -- A student has failed when the Candidacy Committee votes unanimously that the student failed the entire examination. The second examination may have a format different from the first, but the substance should remain the same. A student whose performance on the second attempt is also unsatisfactory, or who does not undertake a second examination within a reasonable period of time, is subject to academic disqualification.

Partial Pass -- A student has partially passed when the Candidacy Committee votes unanimously that the student passed some components but failed others. In this instance, the following apply:

- The student has the option of taking a second examination as detailed in above on the components failed; and

- The chair of the committee must write a letter to the student, with a copy to the Graduate Division, conveying the information about the student's performance (pass, fail, or partial pass) on each of the components covered during the examination.

If a unanimous decision takes the form of "Partial Pass" or "Fail," the Chair of the Candidacy Committee must include in its report a specific statement, agreed to by all members of the committee, explaining its decision and must inform the student of its decision.

If the Candidacy Committee cannot reach a unanimous decision concerning a pass, fail, or partial pass, the chair should determine the areas of disagreement. The committee chair must request, and each committee member must write, a detailed assessment of the student's performance for submission to the Vice Provost and Graduate Dean. The committee should only inform the student that the matter was sent to the Vice Provost and Graduate Dean for a final decision. The student has neither passed or failed the exam until the Vice Provost and Graduate Dean decides the results.

The committee must send the formal Report, signed by all the committee members, to the Vice Provost and Graduate Dean. The exam chair is also responsible for ensuring that assessment materials related to the Qualifying Examination are completed by committee members and submitted to assessment staff in a timely fashion.

A student who has failed the examination may repeat the Qualifying Examination after a preparation time of at least three months. The examination must be held by the same committee except that members may be replaced, with the approval of the Graduate Program Chair, for cause such as extended absence from the campus. Failure to pass the examination on the second attempt means that the student is subject to disqualification from further study for the doctoral degree. After a second examination, only Pass or Fail is recognized by the Vice Provost and Dean of Graduate Education.

3.9. Dissertation Requirements:

The Ph.D. dissertation must be a creative and independent work that can stand the test of peer review. The expectation is that the material will serve as the basis for publication(s) in peer-reviewed journals. The student is encouraged to discuss both the substance and the preparation of the dissertation with members of the dissertation faculty committee well in advance of the planned defense date. Usually, the committee consists of three members, two of whom are from the major area and one from a different area. Detailed instructions on the form of the dissertation and abstract may be obtained from the Graduate Division.

Once the student and advisor are in agreement that the dissertation is ready to be defended, the defense may be scheduled by the student in consultation with the committee. The student must provide a copy of the dissertation to each member of the faculty committee and allow each committee member at least two weeks to read and comment on it. If one or more committee members believe that there are significant errors or shortcomings in the dissertation, or that the scope or nature of the work are not adequate, the student must address these shortcomings before the defense can take place. The scheduled date for the defense must be reported to the Vice Provost and Dean of Graduate Education, and one copy of the dissertation filed by the end of the semester in the term in which the degree is to be conferred.

The Ph.D. dissertation defense consists of an open seminar on the dissertation work followed by a closed-door examination by the dissertation committee. During the examination, the student is expected to explain the significance of the dissertation research, justify the methods employed, and defend the conclusions reached. At the conclusion of the examination, the committee shall discuss whether both the written dissertation and the student's performance on the exam are of satisfactory quality to earn a University of California Ph.D. degree. As per the Graduate Policies and Procedures Handbook, the committee shall reach a unanimous recommendation to pass, fail or partial-pass. Partial-pass will be contingent to corrections and/or revisions to the dissertation.

In this case the committee will select one member, normally the graduate research advisor, who will be responsible for approving the final version of the dissertation that is submitted to Graduate Division. All members of the dissertation committee must sign the final dissertation.

Upon completion of the final examination and approval of the dissertation, the Doctoral Committee recommends, by submission of the Report on Final Examination of the Ph.D. Degree Form, the conferral of the Ph.D. subject to final submission of the approved dissertation for deposit in the University Archives. The Committee recommendation must be unanimous.

Detailed information and instructions on the submission and filing of the dissertation is available in the UCM Thesis and Dissertational Manual. A schedule of dates for filing the thesis in final form are published on the Graduate Division website in the [Dates and Deadlines](#) section.

3.10. Normative Time to Degree:

For students who are engaged in full-time study normative Time to Advancement to Candidacy in Bioengineering is four semesters for students who pursue the Ph.D. directly after the bachelor's degree. Normative Time in Candidacy, which are the remaining semesters recommended for completion of the dissertation, is six semesters. Normative time for completion of the Ph.D. degree for a student entering the program with an approved M.S. degree is 4 years.

3.11. Typical Timeline and Sequence of Events

Year/Semester	Activities
Year 1 (Semesters 1,2)	Learn about research
	Take classes
Summer 1	Begin full-time research with Ph.D. advisor
Year Two (Semesters 3,4)	Continue full-time research with Ph.D. advisor
	Take one class per semester if necessary
	Assemble Candidacy Committee (beginning 3 rd semester)
	Prepare for qualifying exam
	Schedule qualifying exam (4 th semester) – defend Ph.D. research proposal and advance to candidacy
Year Three (Semesters 5,6)	Assemble Doctoral Committee, which can be same as Candidacy Committee
	Conduct research
	Prepare manuscripts for publication
	Present work at scientific conference; network for career
	Apply for candidacy after passing qualifying exam & completing all coursework
Year Four (Semesters 7,8)	Conduct research
	Continue preparing manuscripts for publication
	Present work at scientific conference; network for career
Year Five (Semesters 9,10)	Conduct research
	Present work at scientific conference; network for career; publish
	Declare candidacy for graduation (ninth semester)
	Defend and publish dissertation (tenth semester)

Year	Fall Semester	Spring Semester
1	BIOE 205: Molecular and Cell Biophysics (4 units) BIOE 232: Nano & Bio Fabrication for IB3 (4) BIOE 230: Computation & Modeling for IB3 (4)	BIOE 215: Biological Imaging and Spectroscopy (4 units) BIOE 211: Synthetic Biology (3) BIOE 295: Graduate Research (4) BIOE 291: BIOE Seminar Series (1)

2	BIOE 210: Biothermodynamics, Kinetics and Biotransport (4 units) BIOE 260: Advanced Biomedical Imaging (3) BIOE 295: Graduate Research (4) BIOE 291: BIOE Seminar Series (1)	BIOE 270: Human Physiology for engineering (4 units) BIOE 240: Biomolecular Engineering (4) BIOE 295: Graduate Research (3) BIOE 291: BIOE Seminar Series (1)
3	BIOE 295: Graduate Research (11 units) BIOE 291: BIOE Seminar Series (1) Complete dissertation research proposal and pass oral Qualifying Exam	BIOE 295: Graduate Research (12)
4	BIOE 295: Graduate Research (12) Teaching assistant	BIOE 295: Graduate Research (12) Open Technical Seminar
5	BIOE 295: Graduate Research (12)	BIOE 295: Graduate Research (12) Complete and defend dissertation

3.12.Sources of Funding:

To the extent available resources allow, financial support will be provided for Ph.D. students, and is normally offered as stipend support in the form of appointment as either Teaching Assistants (TAs) or Graduate Student Researchers (GSRs). Students in their first semester of residence usually serve as TAs for appropriate courses in the schools of Natural Sciences or Engineering. After the first semester, support may be offered through either funding as a TA or a GSR in the graduate advisor's laboratory. TA stipends are set by the schools while GSR stipends are determined by the Graduate Group.

While every effort will be made to provide employment as a TA or GSR for Ph.D. students in residence, admission to graduate study carries no guarantee of financial support. No student can be a TA for more than 12 semesters and usually only 2 semesters.

Non-resident international Ph.D. students who have not advanced to candidacy are eligible to receive a NRST award for their first four semesters to specifically cover the NRST fee charged to their student account based on the criteria specified in the Graduate Handbook. They are also eligible for an additional two semesters of NRST award that may either be used before candidacy, or be used three or more years after advancing to candidacy (NRST is waived for the first three years post-candidacy for international students). Ph.D. students who are U.S. citizens or permanent residents classified as non-California residents are eligible only during their first two semesters of graduate study at UC Merced. Please note that NRST awards are not guaranteed and subject to available funds.

3.13. Leaving the Program Prior to Completion of the Ph.D. Requirements

A student admitted for the Ph.D. degree, who, in the judgment of student's Candidacy Committee should not continue past the Master's degree, must be notified in writing by the Graduate Group Chair. A copy of the letter must be sent to the Vice Provost and Graduate Dean. In some cases, a doctoral student may choose to leave the program with a

Master's degree only; the doctoral student must, however, meet the requirements of the M.S. degree. It is the responsibility of the Graduate Group Chair to notify the Graduate Division via the Change of Degree form so that the student's record may be updated to reflect the student's degree status. This notice must include the student's written permission to have his/her degree objective changed officially from Doctorate to Master's.

Transferring from M.S. to Ph.D. Program

An M.S. student who wants to transfer to the Ph.D. program before finishing his or her M.S. degree must go through a Ph.D. admission process managed by the Bioengineering Admissions Committee. This involves submitting a new Statement of Purpose addressing a possible dissertation topic, three new letters of recommendation (typically from Bioengineering faculty), a CV and a transcript to the Admissions Committee, as well as filling out the Change in Degree form (see Graduate Division P&P Handbook).

Earning a M.S. while in the Ph. D. Program ("Master's along the way")

At the time of advancement to candidacy, resident Ph.D. students in the Bioengineering Ph.D. program who have not previously earned a Master's degree in bioengineering or similar discipline may obtain a Master's degree while working toward the Ph.D. degree. Students must get the approval of their faculty advisor. The master's degree and the Ph.D. degree may not be conferred in the same term. Actions that are required to obtain the Master's along the way include:

- Complete all course requirements for the appropriate Master's Degree Plan. Courses units cannot be waived due to a prior M.S. Degree (see Section 3, Doctoral Degree Requirements.)
- Submit a publishable manuscript as an addendum to the research proposal submitted for the Qualifying Examination to fulfill the thesis requirement of the M.S. Plan I degree or pass a Comprehensive Examination to fulfill the requirements of the M.S. Plan II degree. Students who choose the latter option must pass the Comprehensive Examination before taking the Qualifying Examination for the Ph.D. degree. The Comprehensive Examination will follow the guidelines for Comprehensive Examinations outlined in Section 2.2.5.
- Pass the Qualifying Examination for the Ph.D.
- At the time of application for the Advancement to Candidacy for the Ph.D., the resident Ph.D. student should indicate on the form the intent to receive the master's degree.
- Apply for graduation for the Master's Degree (specifying Plan I or II) with the Registrar's office once the Advancement to Candidacy for the Ph.D. has been processed.

4. General Information

4.1. PELP, In Absentia and Filing Fee status.

Bioengineering - Policies and Procedures

Information about PELP (Planned Educational Leave Program), In Absentia (reduced fees when researching out of state), and Filing Fee status can be found in the Graduate Group Policies and Procedures Handbook, available on the Graduate Division Website.