I. Introduction

A. Aims and Scope

QSB faculty research covers a wide range of biological subdisciplines, some of which are often housed in clearly defined, separate departments at traditional campuses. The QSB program at UC Merced was founded without departments and institutional boundaries, allowing for the development of a uniquely inclusive graduate program in which molecular biologists, cell and developmental biologists, bioengineers, computational biologists, evolutionary biologists, ecologists, biophysicists, biochemists, and theoretical biologists can interact easily and regularly, fostering new ideas and exciting research collaborations. Faculty in QSB share the common interest of applying or developing quantitative methods to better understand biological systems. Moreover, QSB aims to link the biological subdisciplines by training our students in quantitative and systems approaches that can be applied to biological systems at different scales and through the promotion of multidisciplinary collaborations.

B. Admissions Requirements

All persons seeking admission to graduate standing must submit a formal application for admission to the UCM Graduate Division. Consideration for admission into the QSB graduate program requires a bachelor's degree (or equivalent four-year undergraduate degree), three letters of recommendation from instructors or supervisors who can comment on the applicant's scholarly ability and promise as a researcher, official transcripts, GRE scores for the general exam, TOEFL or IELTS score (if applicable) and submission of the graduate online application with fee by the stated admission deadline.

A minimum GPA of 3.0 is required. The graduate program may seek to waive this minimum by written petition to graduate division, under circumstances when the applicant has demonstrated strong academic or professional skills subsequent to their undergraduate studies, has documented extenuating circumstances during their undergraduate studies, or other mitigating considerations apply in the student's academic and professional record. Foreign students from non-English speaking countries are required to attain a minimum score of 580 on the TOEFL exam (paper version) or 230 (computer-based version), as well as a score of at least 45 on the TSE.

Applications will be accepted for enrollment in the fall semester. Enrollment in other semesters will be considered on a case by case basis. Applicants are encouraged to contact individual faculty members to discuss their research interests before applying for graduate study.

1. Prerequisites

No specific topics of coursework are required as a prerequisite for admission to the program.

2. Admission Decisions

Applications are reviewed by the QSB Admissions Committee, in accordance with the QSB Admission Policy[1]. Admission decisions are made on a case by case basis. Meeting some or all of the admission criteria does not guarantee admission, but merely eligibility. Performance at prior academic institutions and on the GRE, accomplishments in undergraduate or Master's level research, and letters of recommendation are important determinants of an applicant's potential for success in graduate education and will be evaluated by the admissions committee. Each academically qualified student will also have a virtual or in-person interview with one or more QSB faculty members. Finally, the match of the candidate's skills and interests to QSB research programs will be considered[2]. The Admissions Committee will send their admission recommendations to the Chair of the Graduate Program, who will then approve or deny the recommendation to the Vice Provost and Dean of Graduate Education on the basis of available space and the competitiveness of applicants compared to the eligible pool.

3. Deficiencies

Not applicable.

C. General Committees

1. Executive Committee

The Executive Committee will consist of seven members who will serve rotating terms of five years. The seven members will act as Group chair, Secretary, Treasurer, Educational Policy Committee chair, Recruitment Committee chair, Admissions Committee chair, and Awards Committee chair. The Group chair will serve as an *ex officio* member of the Committee. Members can be re-elected and serve two consecutive five year terms but must sit out one election cycle before running for a third term.

2. Membership Committee

The Membership Committee will consist of three faculty members and will be responsible for reviewing applications from faculty who wish to be part of the Group. In addition, the Committee will review the membership of the Group every four years. The Membership committee will recommend approval or denials for membership to the EC.

3. Educational Policy Committee

The Committee on Educational Policy (EPC) will consist of three faculty members and is responsible for establishing and guiding the educational Groups of the Group. The EPC will be formed by the Executive Committee as needed and will periodically conduct reviews of the Groups, including the five-year review. The EPC in consultation with the group faculty will determine changes in requirements of the QSB Graduate Group.

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[1] The QSB Admission Policy has been attached to this document as supplemental information.

[2] Applicants are encouraged to contact individual faculty members to discuss their research interests before submitting a full application.

4. Recruitment Committee

The Recruitment committee will consist of three faculty members and is charged with the development of recruiting materials for the Group, promotion and representation of the Group to prospective students, and identification and coordination of recruitment partnerships between QSB and other institutions.

5. Admissions Committee

The Admissions committee will consist of three faculty members and is charged with reviewing applications for admissions, making recommendations for admissions to the Dean of Graduate Studies, exploring graduate student support mechanisms, and allocating intramural financial assistance.

6. Awards Committee

The Awards committee will consist of three faculty members and is charged with soliciting applications and/or nominations for various awards such as fellowships, travel awards, and retreat awards, and with evaluating the nominations and applications that it receives.

II. Master's Degree Requirements (to be filled in after fleshing out PhD)

A. Degree Plan I: Thesis

B. Degree Plan II: Non-thesis

III. Doctoral Degree Requirements

A. Program Learning Outcomes (PLOs):

1. Quantitative and Systems Biology Skill (QB/SB)

Knowledge and understanding of quantitative (statistical, computational, and model dependent) and high-throughput experimental systems approaches to biological problems, and demonstrated ability to conceive, plan, execute and/or interpret the applications of these approaches to research questions.

2. Ethics

Knowledge and understanding of ethical standards in proposing and executing professional scientific research.

3. Teaching/Communication

Ability to effectively assist in the teaching of science in a classroom environment, and engage in effective communication of original and existing scientific inquiry and results orally and in writing.

4. Scholarship

Ability to undertake and demonstrate original graduate level scholarship in specialized areas of biology, including integrative command of historical and current literature and broader scientific context, and identification of open research problems.

5. Research Ability

Ability to propose and defend a feasible research plan to apply scientific techniques to open research problems and execute, complete and defend original research that advances scientific knowledge.

B. Dissertation Overview

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. The expectation for QSB graduate students is that the PhD will be completed within five years. Please discuss any departures from this expectation with your graduate research advisor, Doctoral Committee, and the Program Chair. 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. A student completes the Ph.D. degree upon fulfillment of all program degree requirements and thus demonstrating the ability to undertake original graduate level scholarship in his/her specialized areas of biology.

C. Course Requirements

1. Summary

Students must 1) complete at least four semesters of full-time academic residence (12 units minimum each semester) at UC Merced; 2) Complete at least two of the Program's graduate courses worth at least 3 units each, one from among the QSB courses satisfying the Quantitative Biology requirement and the other chosen from among the QSB courses satisfying the Systems Biology requirement; 3) Complete one additional QSB course worth at least 3 units; 4) Complete 1 unit of QSB 294 and at least 2 units of QSB 291; and 5) Complete additional units as needed of upper-division coursework, graduate coursework, or research and discussion units with a cumulative grade-point average of at least 3.0, and a semester GPA not below 3.0 for two consecutive semesters. All coursework must be

completed with an S or a letter grade of at least B[3] to count toward these requirements. Per UC regulations students cannot enroll in more than 12 units of graduate level courses per semester.

2. Core Courses

a) Core Courses

All students must take at least 3 units that satisfy the Quantitative Biology requirement, at least 3 units that satisfy the Systems Biology requirement, and at least three units from one additional graduate level QSB course. Other courses may be substituted by petition to the EPC. Additional courses beyond these three may be taken as determined by the individual student's background and research topic in consultation with the student's Doctoral Committee.

(1) Quantitative Biology

The following courses satisfy the quantitative biology requirement, with an S or a letter grade of at least B. If the student has a grade point average of at least 3.0 in all courses applicable to the degree, one UCM course in which a grade of B- is earned may be accepted by the petition process.

Course Number	Course Name	Units
QSB 207	Physical Biochemistry	3
QSB 214	Tissue Engineering	3
QSB 246	Community Ecology	3
QSB 251	Advanced Molecular Immunology	3
QSB 271	Advanced Neurobiology: Brain Dysfunction and Neurodegenerative Diseases	3
QSB 280	Advanced Mathematical Biology	3
QSB 281	Molecular Dynamics and Biomolecular Simulation	4
QSB 282	Bioinformatics	5

(2) Systems Biology

The following courses satisfy the systems biology requirement, with an S or a letter grade of at least B. If the student has a grade point average of at least 3.0 in all courses applicable to the degree, one UCM course in which a grade of B- is earned may be accepted by the petition process.

Course Number	Course Name	Units
QSB 200	Molecular Cell Biology	3
QSB 215	Principles of Biological Technologies	3
QSB 290	Current Topics in Quantitative and Systems Biology	3
QSB 297	Systems Biology: From Molecules to Metabolic Networks	3

[3] If the student has a grade point average of at least 3.0 in all courses applicable to the degree, one UCM course in which a grade of B- is earned may be accepted by the petition process.

(3) Additional Core Course

Three additional units must come from one additional graduate level QSB course (excluding QSB 291 and QSB 295). QSB 201, QSB 249, QSB 270, and QSB 296 may be used to fulfill this requirement by petition if no other available course meets student's needs. Check the UCM course catalog for a current list of classes. The intent of this requirement is deepened training in a specialized areas of biological science. Other courses may be substituted by petition to the EPC. To satisfy this requirement, courses must be completed with an S or a letter grade of at least B. If the student has a grade point average of at least 3.0 in all courses applicable to the degree, one UCM course in which a grade of B- is earned may be accepted by the petition process.

3. Other course requirements

a) Responsible Conduct of Research

All students must take 1 unit of QSB 294, typically during the first year of residence

Course Number	Course Name	Units
QSB 294	Responsible Conduct of Research	1

b) Seminar

All students must take 2 units of QSB 291, typically during the first year of residence

Course Number	Course Name	Units
QSB 291	Research Forums in Quantitative and Systems Biology	1

c) Research and Discussion Units

Each semester, the following courses could be taken to bring a student up to the 12 unit residency requirement. It is expected that the bulk of units each semester will be devoted to QSB 295 (Graduate Research) once the core and other course requirements have been fulfilled.

Course Number	Course Name	Units
QSB 292	Quantitative and Systems Biology Group Meeting	1
QSB 293	Quantitative and Systems Biology Journal Club	1
QSB 295	Graduate Research	1 - 12

4. Additional coursework notes

Graduate students who transfer into our program having taken courses in other graduate programs may make a single petition to EPC on entrance to QSB for fungible equivalence of courses taken. They should be prepared to demonstrate having obtained a suitable grade (equivalent to an S or a letter grade of at least B) in a class of equivalent semester-hours or greater, and syllabus content comparable to that of a requirement being matched.

All requirements for formal course work beyond the minimum are flexible and are determined by the individual student's background and research topic in consultation with the student's Doctoral Committee.

D. Special Requirements

1. Qualifying exam

All students must pass a qualifying exam that includes both a written and oral component (see section III.G for further details.)

2. Teaching Requirement

All students must serve as a Teaching Assistant for at least one semester

3. Technical seminar

All students must present an open technical seminar at least twice while in residence. The topic of the seminar may be the student's own research or it may be any other topic that falls within the areas of study spanned by the program, broadly defined. The seminar may be presented as part of a regular seminar series, at a scientific conference, or, if necessary, as a special seminar. The open presentation given as part of the Ph.D. defense may be counted as one of the required seminars.

4. Publication

The final confirmation of the quality of a Ph.D. dissertation is the ability to publish the research results in a peer-reviewed journal. The research field may influence the timing and work required to publish research results, making it difficult to define the number of publications required for each dissertation. For this reason, whether a student has made sufficient progress for the Ph.D. ultimately will be determined by the student's Doctoral Committee. However, it is expected that the research project should be sufficiently complete to support publication of at least one full manuscript. The student's Doctoral Committee may determine if having simply submitted a manuscript is sufficient to warrant completion of the Ph.D. requirements, although in most cases, acceptance of the manuscript by the journal will be expected (i.e. manuscript "in press" or "in print").[4] The process of writing the manuscript will be undertaken with the assistance and guidance of the student's Research Adviser. Manuscripts should be presented to the Doctoral Committee for examination and approval at the time of the student's dissertation defense.

[4] The publication requirement is intended to encourage the student to view submission of manuscripts as the ultimate goal of any research project, and to teach the student how to organize research projects and write scientific manuscripts.

5. Dissertation defense

All students must present and successfully defend a doctoral dissertation containing an original contribution to □knowledge in the field (see section III.I for further details). □

E. Advising Structure and Mentoring

1. Advising Structure Overview

The Graduate Advisor is the faculty member who supervises the student's research and dissertation. The Doctoral Committee Chair is the faculty member who represents the graduate group in meetings, mediates the interests of the student and advisor, reports meeting outcomes to the graduate group, and is expected to lead committee to consensus. The Graduate Chair, who is appointed by the Vice Provost and Dean of Graduate Education, is a resource for information on academic requirements, policies and procedures, and registration information until the Doctoral Committee is formed. The Graduate Group Coordinator assists students with identifying appointments and general university policies.

2. Selection of a Research Advisor

The heart of the Quantitative and Systems Biology Ph.D. program is the completion of a piece of original scientific research leading to the preparation and defense of a Ph.D. thesis, which occurs in the Graduate Advisor's research lab. To facilitate choice of Graduate Advisor, QSB has implemented two admissions tracks, Declaration and Rotation Track[5]. All applicants, regardless of track, will be evaluated based on the merit of their application. However, to be admitted into the program, Declaration Track applicants need the endorsement of either a single faculty member or multiple faculty members (for co-advisement). The applicant names these faculty at the time they apply to the program. In contrast, Rotation Track applicants indicate research and faculty of interest at the of application, but do not need endorsement of any applicant-designated faculty member(s) to be admitted to the program. Rotation Track applicants effectively postpone the decision of Graduate Advisor until completion of rotations in a minimum of two QSB faculty labs.

Regardless of admissions track, each student should discuss research interests and possible Ph.D. projects with all of the faculty in the program as early as possible, and select a graduate research advisor during the first year of study. □Selection of a graduate Research Advisor must be mutually agreed upon by faculty and student, is subject to approval by the 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 UC Merced. However, the graduate research advisor must be a member of the Quantitative and Systems Biology Program. Students will

[5] See Rotation Track Policy for further details.

be assigned an initial advisor when they first enroll, unless the student has already chosen an advisor.
□

3. Mentoring

QSB has adopted the GC approved **UCM Mentoring Guidelines**.

F. Doctoral Degree Committees

1. Qualifying Exam Committee

The Qualifying Exam Committee in the Quantitative and Systems Biology Program consists of at least three UC senate faculty members. Additional committee members are permitted if warranted by the student's research project, though in total, the majority of committee members on the Qualifying Exam Committee must be affiliated with QSB. The Graduate Research Advisor is not part of the Qualifying Exam Committee. The members of each student's examination committee will select one member to chair the Qualifying Exam Committee. The composition of the Qualifying Exam Committee is typically the same as the Doctoral Committee, with the exception of the Graduate Research Advisor. If necessary to maintain a minimum committee size of three, the Graduate Research Advisor can be replaced for the Qualifying Exam only by another member of the Program, selected by the Chair of the Doctoral Committee in consultation with the student, Research Advisor, and members of the Doctoral Committee. The Qualifying Exam Committee is typically formed by the end of Year 1.

2. Doctoral Committee

a) Overview

All students in the QSB Graduate Program must have a graduate Research Advisor and Doctoral committee. The student's graduate Research Advisor (see section III.E.2), normally in consultation with the student, the Graduate Program and other faculty, recommends appointment of faculty members to advise on and supervise the student's dissertation research, serve on examination committees, and review and pass upon the merits of the doctoral dissertation. Member nominations are submitted to the Graduate Division for formal appointment in accordance with Graduate Council policy

b) Structure

The Doctoral Committee in the Quantitative and Systems Biology Program consists of at least three UC senate faculty members. Additional committee members are permitted if warranted by the student's research project, though in total, the majority of committee members on the Doctoral Committee must be affiliated with QSB. One Doctoral Committee member is the student's graduate research advisor. The two or more other faculty are usually UC Merced faculty members in QSB; one of these other faculty members is appointed as Committee Chair, and the Chair must be a member of QSB. Under some circumstances, additional committee members can be drawn from UC Merced

faculty members from outside the Program, regular or adjunct faculty members 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 Quantitative and Systems Biology graduate program for review and approval by the Membership Committee and appointment as an Affiliate Member.

c) Timeline and Meetings.

The Doctoral Committee must be formed by the end of Year 1. The Doctoral Committee meets as a group at least once per year to be updated on the progress and advise on research directions as necessary. Yearly meetings should be done as a group, with a majority of the committee members present. All members of the committee must be in attendance in person or virtually for Ph.D. qualifying examinations and thesis defense. Following each meeting, the Committee Chair sends a report back to the student, the student's Research Advisor, the QSB Program Chair and the appropriate graduate program staff.

d) Committee membership changes

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 approved by the Chair of the Quantitative and Systems Biology graduate program with consultation from the Executive Committee if requested.

G. Qualifying Examination Requirements

1. General Information.

All students in the Quantitative and Systems Biology Ph.D. program are required to pass a qualifying examination before advancement to candidacy for the Ph.D. degree. Students are expected to take the qualifying examination during their second year of graduate study, unless they successfully petition the Graduate Program Chair to take it at a specific later date. Students entering the Ph.D. program with a M.S. degree may request to take their qualifying exam during their first year, provided their Doctoral Committee approves. The dates for the examination are arranged between the student, their graduate research advisor, and the Qualifying Exam Committee.

2. Components of the Exam.

The qualifying exam consists of a written proposal and an oral examination.

a) Written proposal

One month before the scheduled qualifying exam, the student will provide to the degree committee a written document 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 format of the research proposal will be determined by the student in consultation with their adviser and committee; however the proposal must follow the format of a research proposal to a major funding agency in the student's area of research. The committee will review this document prior to the exam and determine if the student has outlined a project that is appropriate for a Ph.D. If not, the student is given a month to rewrite the research plan. Once the research plan is approved the student may take the oral portion of the Qualifying Examination.

b) Oral Exam

The oral exam may be taken only after the student's written research proposal has been approved by the student's committee (Section III.G.2.a.). The oral exam will focus on the student's research proposal, but may cover any related field of science, and will typically last three hours. The graduate research advisor is encouraged to be available for private consultation with the examination committee at the beginning and/or end of the examination, but may not be present during other times such as student examination and committee deliberation.

3. Outcome of the Exam.

The committee conducts the oral examination, and immediately thereafter submits the results of the full qualifying examination to Graduate Studies. Possible outcomes are:

- Pass (conditions may not be appended to a pass decision)
- Re-Take, with an option to retake the examination within a specified time period, or to satisfy specific other requirements □
- Fail

The committee members should include in their evaluations of the student such factors as relevant portions of the previous academic record, performance on the examination, and an overall evaluation of the student's performance and potential for scholarly research as indicated during the examination. The committee should strive to reach a unanimous decision. If a unanimous decision is reached, the committee shall inform the student of its decision in one of the forms listed above. If the decision is "Re-Take" or "Fail", the Qualifying Exam Committee Chair must include in a report a specific statement, which may include a minority report, explaining its decision and must inform the student of its decision. In the case of a "Re-Take" decision, the committee must include in its report a further statement of its terms and inform the student of those terms. In those cases when it is not possible for the members to resolve their differences, the student should be informed of the nature of those differences and each member should submit a detailed assessment of the student's performance to the Chair of the Graduate Program. The Chair, in consultation with other members of the Graduate Program, will use these individual reports to adjudicate the result.

Upon recommendation of the examination committee, a student who has not passed the examination may repeat the qualifying examination after a preparation time of no more than six months. The examination must be held by the same committee except that members may be replaced, with the approval of the graduate advisor, 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, a vote of RE-TAKE is unacceptable; only PASS or FAIL is recognized by the Dean of Graduate Studies.

H. Advancement to Candidacy

Upon successful completion of the examinations and approval of a research plan, the student is given an application for advancement to candidacy by the Qualifying Exam Committee Chair. When it is filled out and signed by the graduate research, the student pays a candidacy fee and submits the form to Graduate Division. Upon advancement to candidacy for the degree, the Doctoral Committee is then charged to guide the student in research and in the preparation of the dissertation.

I. Dissertation Requirements

1. Dissertation

a) General Information

The Ph.D. dissertation must be 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 a peer-reviewed journal. The work must be the student's, and it must be original and defensible. The student is encouraged to discuss with members of the Doctoral Committee both the substance and the preparation of the dissertation well in advance of the planned defense date. Detailed instructions on the form of the dissertation and abstract may be obtained from the Graduate Division.

The submission of the dissertation is the last step in the program leading to the award of an advanced degree. All dissertations submitted in fulfillment of requirements for advanced degrees at UCM must conform to certain University regulations and specifications with regard to format and method of preparation. The UCM Thesis and Dissertation Manual are available at the Graduate Division website. The Doctoral Committee certifies that the completed dissertation is satisfactory through the signatures of all Committee members on the signature page of the completed dissertation.

Filing instructions are found in the UCM Thesis and Dissertation Manual. The advanced degree manuscript is expected to be submitted by the deadline in the semester in which the degree is to be conferred. The end of the semester is the deadline for submitting dissertations during each semester. Those students who complete requirements and submit dissertations after the end of the semester and prior to the start of the subsequent semester will earn a degree for the following semester, but will not be required to pay fees for that semester. In accordance with UC and UCM policy, all approved thesis/dissertation manuscripts automatically become available for public access and circulation as part of the UC Libraries collections.

2. Final examination

a) General Information

The Ph.D. final examination consists of an open seminar on the dissertation work followed by a closed examination by the faculty 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.

b) Conduct of the Exam

Administration of the final examination is subject to the policies of the Graduate Council governing critical examinations. The student must provide a copy of the written dissertation to each member of the Doctoral Committee and allow each committee member at least four 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 scheduling a defense. Once the committee members are in agreement that the dissertation is ready to be defended, the final examination date may be scheduled by the student in consultation with the committee.

c) Outcome of the Exam

At the conclusion of the final examination, the committee shall vote on whether both the written dissertation and the student's performance on the final exam are of satisfactory quality to earn a University of California Ph.D. degree. All members of the Doctoral Committee must certify that the completed dissertation is satisfactory. A simple majority is required for a pass. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the dissertation. In this case, the committee will select one member, normally either the graduate research advisor or the Doctoral Committee Chair, who will be responsible for approving the final version of the dissertation that is submitted to Graduate Studies. All members of the degree committee must sign the final dissertation.

IV. General Information

A. PELP, In Absentia and Filing Fee status

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 Graduate Division.