PHYSICS

Ph.D. AND MS DEGREE REQUIREMENTS

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A. Introduction

1) **Aims and Scope**: The mission of the Physics graduate program at UC Merced is to train the next generation of scientific leaders. Our graduates will be well prepared to conduct and communicate independent and original research advancing fundamental understanding of the world around us and using physics to solve important problems in society.

2) **Admissions Requirements**: All persons seeking admission to the Physics graduate program must make formal application for admission through the Graduate Division's on-line application system. Applications are reviewed by the Admissions Committee, which makes recommendations on admission to the Graduate Division; the Graduate Dean makes final decisions on admission. The deadline for receipt of applications is listed on the Graduate Division website (https://graduatedivision.ucmerced.edu/) for enrollment in the Fall semester. Applicants are encouraged, but not required, to contact individual faculty members about their areas of research interests prior to applying.

Materials to be submitted:

- The complete official application form;
- The application fee;
- All official university/college/junior college transcripts;
- Three letters of recommendation from people 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) for any applicant who spent the majority of their primary and secondary education in a nation/territory where English is not the primary language.
- Graduate Record Exam (GRE) scores are not required. If the applicant chooses to submit the GRE scores, they will be considered.

The minimum requirement for graduate admission to UCM is a bachelor's degree, or any other degree or certificate which the Graduate Council accepts as equivalent, and a grade point average no lower than 3.0 on a 4.0 scale. This minimum will be waived only under circumstances where the applicant has demonstrated strong academic or research skills subsequent to their undergraduate studies. Accomplishments in undergraduate research and letters of recommendation will also be evaluated as important determinants of an applicant's potential for success in graduate education. TOEFL or IELTS exams are required for some international applicants according to Graduate Division policy.

3) **Committees**: Committee members will be appointed by the physics department chair in consultation with the graduate group chair.

Graduate Affairs Committee

The Graduate Affairs Committee shall determine and implement policy for the good of the Graduate Group and represent the interests of the Graduate Group to the University and other agencies. The Graduate Affairs Committee will consist of at least three members. The Graduate Group chair will serve as an *ex officio* member of the Committee.

Admissions Committee

The Admissions Committee is charged with recruiting for the Graduate Group and reviewing

applications for admissions. The Admissions Committee shall consist of the chair of the Graduate Group, and at least two additional members, one of whom will serve as the Graduate Admissions Chair.

Other

The physics core faculty will vote on every new affiliate faculty request. The physics graduate program chair will survey the affiliate faculty at the end of every Academic Year about whether they wish to renew the affiliate faculty status.

The physics graduate program chair will be a member of the physics curriculum committee responsible for establishing and guiding the educational programs. The graduate program chair in consultation with the Graduate Group faculty will determine changes in coursework, exam, and teaching requirements for students in the Graduate Group. The physics graduate chair and the physics graduate executive committee will periodically conduct reviews of the program and will oversee the self-study associated with formal program reviews.

B. Master's Degree Requirements

1) Degree Plan: Students may be admitted to the graduate program in Physics to work towards a Masters Degree (M.S.). Additionally, a Ph.D. student who has been in residence for at least two semesters, is in good academic standing, and has completed at least the four core courses may petition the Admissions Committee to pursue a terminal M.S. degree. The recipient of a M.S. degree is understood to possess knowledge of a broad field of learning that extends well beyond that attained at the undergraduate level, but is not necessarily expected to have made a significant original contribution to knowledge in that field.

The Physics Graduate Group has established the following requirements for the M.S. degree. Each M.S. student has a committee with at least three faculty members.

- Complete at least two semesters of full-time academic residence at UC Merced;
- Pass the required review course, PHYS 202;
- Complete at least 24 units in approved course work with a cumulative grade-point average of at least 3.0. At least 20 units must be from regular, letter-graded courses, while the remaining 4 units may be research or similar courses; Either (1) Pass a comprehensive oral examination administered by the faculty committee. This examination will test the student's understanding of the main concepts in the field at the graduate level. If the student has advanced to candidacy, the qualifying exam can be used to substitute for the comprehensive oral examination requirement; or (2) Submit a Master's thesis, documenting the progress towards a proposed research or summarizing the research conducted in a research group, supervised by a faculty. The student's candidacy committee shall pass on the content of the thesis, administer a general examination on the master's thesis, and decide whether the thesis is satisfactory or unsatisfactory. The minimal length of the Master's thesis is 15 pages. The PLOs and other requirements are identical for both (1) and (2) above.
- In addition, the M.S. program requires attendance at physics seminars, PHYS 293 and PHYS 251, and M.S. students are recommended to take research units (PHYS 295), to help

fulfill their unit requirements. The mandatory Physics courses are "letter grade only" and students should be aware that grades obtained of B– may land them in a state of unsatisfactory degree progress, as they must maintain an overall GPA of 3.0, and their semester GPA must not remain below 3.0 for two consecutive semesters. Graduate students should also be advised that S/U grades do not count towards GPA calculation by the registrar.

***Residency*:**

A minimum of two semesters in academic residence is required prior to the award of a master's degree (AR 686). The terms and deadlines for formal advancement to candidacy are outlined in the Graduate Division dates and deadlines website (https://graduatedivision.ucmerced.edu/current-students/calendar-and-deadlines). Students must be advanced to candidacy prior to degree conferral. The physics graduate group only accepts full time students. Exceptions will only be granted for students in the Master's Degree program with the permission of the graduate group chair, in consultation with the Executive Committee.

Scholarship: Graduate students must maintain at least a 3.0 grade-point average to be considered in good academic standing or to be awarded an academic graduate degree. A student whose cumulative graduate grade-point average falls below 3.0, or who is judged not to be making satisfactory progress toward the degree by their graduate advisor or faculty committee, will be placed on academic probation. The student will then be allowed a maximum of two semesters to make up the deficiencies and be returned to good academic standing. Otherwise, the student will be subject to academic disqualification from the graduate program. Students may be sent notification of potentially unsatisfactory progress prior to Notices of Unsatisfactory Progress as an early warning.

Specific scholarship requirements are as follows:

1 Only courses in the 100 and 200 series in which the student receives grades of "B" or above, or "S" may be counted in satisfaction of the requirements for advanced degrees. A course in which a student receives a "C" or "D" or lower cannot be used to satisfy the unit requirement for the degree but will count in determining the grade point average.

2 Candidates must maintain an average of at least three grade points per unit in all upper division and graduate courses elected during their residence as graduate students at the University of California. Students must maintain an average grade point of 3.0 for advancement to candidacy and conferral of the degree.

3 Courses graded "S/U" will not be counted in determining grade point averages.

4 Students must make satisfactory progress on their programs of study as determined by their graduate advisor.

***Program Learning Outcomes (PLOs)*:** Graduates of the Physics Masters program will:

1) Possess a broad foundation in the fundamentals of physics and a deep understanding of their chosen subfield, which will permit them to understand and critically evaluate current research.

2) Be proficient in professional skills necessary to lead a productive career in physics or a related career.

3) Communicate both fundamental concepts of physics and details of their own research effectively, in written and oral form, to expert and non-expert audiences.

Course Requirements **- All Masters students in the Physics Graduate Group are required to take:**

A. Core Course Requirements:

To be completed within the first year.

1) PHYS 202 Foundations of Physics

To be completed within the first four semesters.

1) PHYS 237 - Quantum Mechanics I
2) PHYS 210 - Electrodynamics
3) PHYS 212 - Statistical Mechanics
4) PHYS 205 - Classical Mechanics

B. Electives:

To be completed at any time during the Masters:

1) An elective from the Physics graduate courses of at least 3 units listed in the course catalog.
2) A second elective which may be chosen from any graduate level course in the Schools of Natural Sciences or Engineering as long as they are 3 units and taken as a graded class.

C. Additional courses: Students must take 1 unit of QSB 294 Responsible Conduct of Research, 4 semesters of Physics seminar, and 1 unit of PHYS 251 Introduction to Graduate Research.

***Waivers*:** If a student would like to attain a waiver for any core or elective courses based on previous coursework, the rules are:

1. No waiver will be granted unless the student has passed the required review course, PHYS 202.
2. A student can ask for a waiver of only one elective course. All core courses can be waived if competency is demonstrated.
3. For a waiver of any course at UC Merced, the student will need to get approval of the petition from the current or most recent instructor of the corresponding course, who will compare syllabus, transcript, and other course materials to verify appropriate course content and level. The petition will be approved only for grades of A- or above (converted from a different grading scheme if needed), and an exam or course participation may be required for any significant topics not covered in the prior course. Alternately, a student may demonstrate proficiency to the level of an A- on a final exam or equivalent. This exam can be given at any time mutually agreed upon by the faculty and student. The final decision to grant the waiver will be made by the Graduate Dean.
4. A waiver for elective credit based on a relevant course that does not correspond to a course in our physics graduate program can be waived by approval of the graduate group chair,

based on a grade of A- or above.

5. Waivers based on courses before beginning graduate studies at UC Merced must be requested in the first year.

Course electives must be regular graduate courses (not research or independent study). Courses offered by other graduate programs may be taken as electives but require approval of the graduate advisor. Recommendations for course work beyond the minimum are flexible and are determined by the individual student's background and research topic in consultation with the graduate advisor.

All Physics graduate students must successfully complete their core course requirements with a grade of B or better. A student may petition the graduate chair in the case of a single B- grade for an extension until the end of the third year to re-take that course and achieve a grade of B or better, or if the student has already re-taken the class, to audit the class and take the exams, achieving a grade of B or better. In this latter case, the student will notify the instructor to report the grade to the Graduate Group Chair and Graduate Coordinator to confirm satisfaction of this requirement. Graduate students should be aware that grades obtained of B– may land them in a state of unsatisfactory degree progress, as they must maintain an overall GPA of 3.0, and their semester GPA must not remain below 3.0 for two consecutive semesters. Graduate students should also be advised that S/U grades do not count towards GPA calculation by the registrar. A minimum course load is 12 units each academic semester.

***Special Requirements*:** There is no foreign language course requirement. One semester of teaching assistantship is required. As noted in the course requirements, students must take 1 unit of QSB 294 Responsible Conduct of Research and 4 semesters of Physics seminar, PHYS 293. All students in the Graduate Group are required to pass a one-semester review course, PHYS 202, of undergraduate-level understanding of the fundamental concepts in the field. This course is offered in the fall semester every year, and the student is required to take it within the first year unless a petition for taking it at a specific time is approved by the Graduate Program Chair. The course will review three subjects in one course – Classical Mechanics, Quantum Mechanics and Electromagnetism. Each subject is reviewed independently. The grade is S/U. Students who have not taken a subject in undergraduate studies or have had an extended time period since they took the subject may substitute the equivalent undergraduate course(s) at UC Merced, with a requirement to pass with B+ or higher. In this case, the final grade of the review course is based on the remaining subject(s) in the review course, and the student passes the requirement only if the student passes both the review course for the remaining subject(s) and the undergraduate course(s) within the first year. A student must discuss with the instructor of PHYS 202 and the Graduate Program Chair before substituting the undergraduate course(s), and must report the grade(s) of the undergraduate course(s) to the Graduate Program Chair and Graduate Coordinator after completion of the course(s). Students who have not passed the review course by the end of the first year, or as approved by petition, are subject to academic disqualification.

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 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.

***Comprehensive Examination and Master's thesis*:** For the non-thesis track, the comprehensive exam is a 2 hour long oral exam administered by the student's faculty committee at the end of the fourth semester. When students take the exam, they must be registered or in current filing fee status. The scope of the oral exam is the candidate's coursework. The committee's unanimous vote is required to pass a student on the exam. If a student does not pass the exam, the committee may recommend that the student be reexamined one more time on the entire examination or on the components failed. The second exam must take place within 15 calendar days of the first exam. The second exam may have a format different from the first, but the substance should remain the same. The examination may not be repeated more than once. A student who does not pass on the second attempt is subject to disqualification from further graduate work in the program. Once passed, the Final Report for the Master's Degree Form is signed by the Program Graduate Chair and then submitted to the Graduate Division. The deadlines for completing this requirement are listed each semester in the Graduate Division website. The committee must report the outcome to the Graduate Council via the Vice Provost and Graduate Dean within 30 days. In the case of a "masters along the way" for a student in the PhD program, the qualifying exam may serve as the comprehensive exam, with the corresponding requirements as stated for the PhD program replacing the provisions in this paragraph.

For the master's thesis track, the student may submit a Master's thesis, documenting the progress towards a proposed proposal or summarizing the research conducted in a research group, under the supervision of a faculty. The Master's thesis needs to be reviewed by the student's candidacy committee. The student's committee will administer a general examination on the thesis and decide whether the master's thesis is satisfactory or unsatisfactory. Once the submission of the Master's thesis is completed, the Final Report for the Master's Degree Form is signed by the Program Graduate Chair and then submitted to the Graduate Division. The deadlines for completing this requirement are listed each semester in the Graduate Division website.

2) Advising Structure and Mentoring: Masters students are mentored by a graduate advisor who is appointed by the Graduate Group Chair and is a resource for information on academic requirements, policies and procedures, and registration information. The Graduate Group Coordinator may assist students with identifying teaching and research appointments and general university policies. Mentoring practices are consistent with UCM Mentoring guidelines (https://graduatedivision.ucmerced.edu/sites/graduatedivision.ucmerced.edu/files/page/documents/ucm_mentoring_guidelines-_gc_approved_9_23_14-2_1.pdf).

3) Master's Degree Committees:

***Comprehensive Examination/Master's Thesis Committee*:** The student, in consultation with their graduate advisor and graduate group chair, nominates three UCM senate faculty (including the advisor) to serve on the Comprehensive Examination or Master's Thesis Committee. These nominations are submitted to the Vice Provost and Dean of Graduate Education for formal appointment in accordance with Graduate Council policy. This committee of three faculty members shall approve the subject, and content of the examination, and administer the examination or review the Master's thesis. Usually one of the committee members directs the examination or organizes the thesis review.

4) Normative Time to Degree: The normative time to degree is two years (four semesters).

5) Typical Timeline and Sequence of Events: A Sample Plan for Completing the M.S. Degree in

the Normative Time to Degree is shown in this table below.

Fall 1	**Spring 1**	**Fall 2**	**Spring 2**
PHYS 210 C (4) Electrodynamics and Optics I	PHYS 237 C (4) Quantum Mechanics I	PHYS 241 (4) Condensed Matter Physics	PHYS 242 (4) Advanced Condensed Matter Physics
PHYS 205 C (4) Classical Mechanics	PHYS 212 C (4) Statistical Mechanics	QSB 294 (1) Responsible Research	
PHYS 295 (1) (rotation) Graduate Research	PHYS 295 (3) (rotation) Graduate Research	PHYS 295 (6) Graduate Research	PHYS 295 (7) Graduate Research
PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium
PHYS 251 (1) Introduction to Graduate Research			Pass Comprehensive Exam
PHYS 202 (1) Foundations of Physics			

6) Sources of Funding: Graduate students who received a funding offer with their admissions offer will have their financial support according to the terms of the funding offer. Funding will come through a combination of Teaching Assistantships, graduate Research Assistantships, and/or Fellowships. Master's students are typically not expected to be funded by such means; but they may receive a funding offer with their admissions offer. More information on financial support can be found in the Graduate Policies and Procedures Handbook.

C. Doctoral Degree Requirements

The Doctor of Philosophy degree is not granted by the University of California merely for the fulfillment of technical requirements, such as residence or the completion of fundamental courses. The recipient of a Ph.D. degree is understood to possess thorough knowledge of a broad field of learning and to have given evidence of distinguished accomplishment in that field; the degree is a warrant of critical ability and powers of imaginative synthesis. The degree also signifies that the recipient has successfully presented a doctoral dissertation containing an original contribution to knowledge in their chosen field of study.

The Physics Graduate Group has established the following requirements for the Ph.D. degree:

- Complete at least four semesters of full-time academic residence at UC Merced;
- Complete the required courses with a letter grade of at least "B" in each course ("S" in colloquium courses graded S/U);
- Serve as a teaching assistant for at least one semester;
- Pass the required review course, PHYS 202, within the first year;
- Pass the Ph.D. qualifying examination and advance to candidacy;
- Present and successfully defend a doctoral dissertation containing an original contribution to knowledge in the field.

Residency: The minimum residency requirement for the Ph.D. degree is four semesters. Graduate students are admitted to candidacy after completion of all candidacy requirements and approval of a formal application by the Graduate Division. For the purposes of determining academic residency, only the Fall and Spring semester will be counted; however, the summer semester may be counted in evaluating students on academic probation. The physics graduate group only accepts full time students. Full-time enrollment is defined as 12 units per semester. Ordinarily, a graduate student shall not receive credit for more than 12 units of graduate courses in any semester.

Scholarship: Graduate students must maintain at least a 3.0 grade-point average to be considered in good academic standing or to be awarded an academic graduate degree. A student whose cumulative graduate grade-point average falls below 3.0, or who is judged not to be making satisfactory progress toward the degree by their graduate advisor or faculty committee, will be placed on academic probation. The student will then be allowed a maximum of two semesters to make up the deficiencies and be returned to good academic standing. Otherwise, the student will be disqualified from the graduate program. Students may be sent notification of potentially unsatisfactory progress prior to Notices of Unsatisfactory Progress as an early warning.

Specific scholarship requirements are as follows: Only courses in the 200 series in which the student receives grades of "B" or above, or "S" may be counted in satisfaction of the requirements for advanced degrees. A course in which a student receives a "C" or "D" or lower cannot be used to satisfy the unit requirement for the degree but will count in determining the grade point average.

• Candidates must maintain an average of at least a 3.0 grade points in all graduate courses elected during their residence as graduate students at the University of California. Students must maintain an average grade point of 3.0 for advancement to candidacy and conferral of the degree. Courses graded "S/U" will not be counted in determining grade point averages.

• Students must make satisfactory progress on their programs of study as determined by their graduate research advisor and their PhD committee.

1. Program Learning Outcomes (PLOs):

Graduates of the Physics PhD program will:

1) Possess a broad foundation in the fundamentals of physics and a deep understanding of their chosen subfield, which will permit them to understand and critically evaluate current research.

2) Have the experimental, theoretical, and/or computational skills necessary to conduct and lead independent responsible research and contribute to knowledge in their chosen subfield

3) Identify new research opportunities, which may cross traditional discipline boundaries, plan effective strategies for pursuing these opportunities and conduct research that makes a new contribution to knowledge in their chosen subfield of physics and solve important problems in society.

4) Communicate both fundamental concepts of physics and details of their own research effectively, in written and oral form, including in a classroom setting to expert and non-expert audiences. This includes the publication of original research results in peer reviewed scientific journals.

2. Course Requirements - (22 units minimum)

All Ph.D. students in the Physics Graduate Group are required to take:

A. Core Course Requirements:

To be completed within the first year.

1) PHYS 202 – Foundations of Physics

To be completed within the first four semesters.

1) PHYS 237 - Quantum Mechanics I
2) PHYS 210 - Electrodynamics
3) PHYS 212 - Statistical Mechanics
4) PHYS 205 - Classical Mechanics

B. Electives: To be completed at any time during the PhD:

1) An elective from the Physics graduate courses of at least 3 units listed in the course catalog.

2) A second elective which may be chosen from any graduate level course in the School of Natural Sciences or Engineering as long as they are at least 3 units and taken as a graded class.

C. Additional courses:

In addition, students must take 1 unit of QSB 294 Responsible Conduct of Research, 4 semesters of Physics seminar PHYS 293, 1 unit of PHYS 251 Introduction to Graduate Research. Other courses may be added to these lists as fulfilling the requirements at any time, as designated by the physics faculty.

The courses noted above and electives together constitute a minimum of 22 units. This does not include research units that will be taken as described below.

If a student would like to attain a waiver for any core or elective courses based on previous coursework, the rules are:

1. No waiver will be granted unless the student has passed the required review course, PHYS 202.

2. A student can ask for a waiver of only one elective course. All core courses can be waived if competency is demonstrated.

3. For a waiver of any course at UC Merced, the student will need to get approval of the petition from the current or most recent instructor of the corresponding course, who will compare syllabus, transcript, and other course materials to verify appropriate course content and level. The petition will be approved only for grades of A- or above (converted from a different grading scheme if needed), and an exam or course participation may be required for any significant topics not covered in the prior course. Alternately, a student may demonstrate proficiency to the level of an A- on a final exam or equivalent. This exam can be given at any time mutually agreed upon by the faculty and student. The final decision to grant the waiver will be made by the Vice Provost and Graduate Dean.
4. A waiver for elective credit based on a relevant course that does not correspond to a course in our physics graduate program can be waived by approval of the graduate group chair, based on a grade of A- or above.
5. Waivers based on courses before beginning graduate studies at UC Merced must be requested in the first year.

Course electives must be regular graduate courses (not research or independent study). Courses offered by other graduate programs may be taken as electives but require approval from the graduate advisor. Recommendations for course work beyond the minimum are flexible and are determined by the individual student's background and research topic in consultation with the graduate advisor.

All Physics graduate students must successfully complete their core course requirements with a grade of B or better. A student may petition the graduate chair in the case of a single B- grade for an extension until the end of the third year to re-take that course and achieve a grade of B or better, or if the student has already re-taken the class, to audit the class and take the exams, achieving a grade of B or better. In this latter case, the student will notify the instructor to report the grade to the Graduate Group Chair and Graduate Coordinator to confirm satisfaction of this requirement. Graduate students should be aware that grades obtained of B– may land them in a state of unsatisfactory degree progress, as they must maintain an overall GPA of 3.0, and their semester GPA must not remain below 3.0 for two consecutive semesters. Graduate students should also be advised that S/U grades do not count towards GPA calculation by the registrar.

Research units: Full-time students must enroll in 12 units per semester, including research, academic and seminar units. Courses that fulfill any of the program course requirements may not be taken S/U. Once course requirements are completed, students can take additional classes as needed; generally full-time enrollment is fulfilled with research credit courses (PHYS 295). Per UC regulations students cannot enroll in more than 12 units of graduate level courses per semester.

3. Special Requirements: There is no foreign language course requirement. All students will be required to TA for at least one semester as long as a suitable TA position is available. A student may petition to have TA or lecturership experience at other institutions satisfy this requirement. As noted in the course requirements, students must take 4 semesters of Physics seminar, 1 unit of QSB 294 Responsible Conduct of Research, and 1 unit of PHYS 251 Introduction to Graduate Research.

All students in the Graduate Group are required to pass a one-semester required review course

PHYS 202 of undergraduate-level understanding of the fundamental concepts in the field. This course is offered in the fall semester every year, and all students are required to take it within their first year unless a petition for taking it at a specific time is approved by the Graduate Program Chair. The course will review three subjects in one course – Classical Mechanics, Quantum Mechanics and Electromagnetism. Each subject is reviewed independently. The grade is S/U. Students who have not taken a subject in undergraduate studies or had an extended time period since they took the subject may substitute the equivalent undergraduate course(s) at UC Merced, with a requirement to pass with B+ or higher. In this case, the final grade of the review course is based on the remaining subject(s) in the review course, and the student passes the requirement only if the student passes both the review course for the remaining subject(s) and the undergraduate course(s) within the first year. A student must discuss with the instructor of PHYS 202 and the Graduate Program Chair before substituting the undergraduate course(s), and must report the grade(s) of the undergraduate course(s) to the Graduate Program Chair and Graduate Coordinator after completion of the course(s). Students who have not passed the required review course by the end of their first year, or as approved by petition, are subject to academic disqualification.

4. 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. It is the responsibility of the Graduate Group to inform the student upon admission to the program of the expected degree time. 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. The elective courses are requirements for the PhD degree but not for advancement.

5. Advising Structure and Mentoring:

Selection of advisor: The heart of the Physics Ph.D. program is the completion of a piece of original scientific research leading to the preparation and defense of a Ph.D. thesis. To this end, each student should discuss research interests and possible Ph.D. projects with faculty in the Graduate Group as early as possible, and must select a graduate research advisor by the end of the first year of study. Selection of a graduate research advisor must be approved by the graduate group 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 and collaborations with faculty or senior scientists outside UC Merced are welcome.

Rotations: Students will be assigned two mentors, one each for the first two semesters, when they first enroll, based on the preferences they indicate and faculty availability and interest. The first mentor assignment will be done by the graduate group chair prior to the start of the fall semester. Physics core faculty (https://physics.ucmerced.edu/people#Faculty) will be given preference over affiliates. The second mentor assignment will be done at the end of fall semester by the graduate group in consultation with the graduate students. The second rotation mentor may be either a Physics or an affiliate faculty member (https://physics.ucmerced.edu/people#Affiliate%20Faculty), and could be the same as the first

mentor. Students will perform rotations of 1-3 research units in each assigned mentor's lab. Rotations will typically consist of activities that form part of the group's routine, including attending and presenting at group meetings, one-on- one weekly meetings with the mentor, literature review and readings and possible work on short-term projects. Rotations are for the students to gain exposure to different working environments, integrate into the graduate student community and learn more about ongoing research. Requests for changes to the assigned mentors can be made and approval will be granted at the discretion of the graduate group chair. There is no implied commitment from either mentor to take on the students nor are students required to choose one of the two mentors as their graduate research advisor.

For assistance with selecting an advisor, each student will meet with the graduate group chair during the spring semester if the student has not yet decided on a research advisor. If a match is not made with one of the two rotation mentors, the graduate group chair will assign a third rotation mentor for the student, in consultation with the student and other faculty members. If at the conclusion of the first year a suitable faculty advisor is not determined, then the student will be recommended for academic disqualification from the program, unless the student successfully petitions the Graduate Group Chair for an extension.

Graduate advisors are also a resource for information on academic requirements, policies and procedures, and registration information and can minimally direct the students to the appropriate information. The Graduate Group Coordinator assists students with identifying appointments and general university policies. Mentoring practices are consistent with UCM Mentoring guidelines:
(https://graduatedivision.ucmerced.edu/sites/graduatedivision.ucmerced.edu/files/page/documents/ucm_mentoring_guidelines-_gc_approved_9_23_14-2_1.pdf).

Individual Development Plan (IDP): Once the student selects a PhD advisor, the student will prepare an IDP in a format as specified on the physics graduate group website at https://physics.ucmerced.edu/graduate-studies, with assistance from the advisor. This document will then be annually updated by the student and assessed by the doctoral/candidacy committee.

6. Doctoral Degree Committees: The graduate advisor, normally in consultation with the student and other program faculty, recommends appointment of faculty members to advise on and supervise the student's dissertation research as part of their examination committees. Final approval of the membership on these committees rests with the Graduate Dean. The Candidacy Committee is charged with determining the fitness of the student to proceed with the doctoral dissertation through a formal Qualifying Examination. The Doctoral Committee shall supervise the preparation and completion of the dissertation and the final examination. In the Physics Graduate Group, one committee shall serve as both candidacy and doctoral committee for a single student.

- This committee must be formed before the start of the second year.

- This committee will meet at least once a year to evaluate the student's progress. At this meeting the student will share the IDP with the committee and give a brief oral presentation on their achievements over the last year. The comments from the committee will be submitted to the graduate group.

Advanced degree committees in the Physics Graduate Group shall consist of at least three UCM

senate faculty members. One must be the student's Physics graduate advisor, one other must be a Physics core faculty member who is not an advisor of the student (who is also appointed as Chair), and one other who may be from outside the Graduate Group. In addition to the three UCM senate faculty members, the committee may consist of outside member(s). The outside member(s) may be 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. A curriculum vitae must be submitted to the Graduate Dean for review and approval.

A student may opt to choose a graduate advisor from among the affiliate faculty (https://physics.ucmerced.edu/people#Affiliate%20Faculty). In such a case a nominal additional advisor from the Physics faculty (https://physics.ucmerced.edu/people#Faculty) will be assigned in addition to the regular committee membership and will be responsible for ensuring the appropriateness of the student's research project.

All members of the committee must be in attendance for Ph.D. qualifying and final examinations or Master's comprehensive oral examination. All members of the committee must approve the Ph.D. dissertation. 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 petition must be reviewed and approved by the Graduate Dean.

7. Advancement to Candidacy: All students in the Physics Ph.D. program are required to pass a qualifying examination before advancement to candidacy for the Ph.D. degree. Students are expected to have their pre-qualifying evaluation by the end of their second year unless they successfully petition the Graduate Group Chair to complete it at a specific later date. Failure to complete the pre-qualifying evaluation by the end of the second year may result in a potential unsatisfactory status. Students are expected to take and pass the qualifying examination before the end of their third year of graduate study or exit with a Master's degree if the Master's degree requirements are fulfilled. The qualifying examination may not be scheduled until the required review course PHYS 202 has been passed and the four core courses have been completed. The intent of this examination is to ascertain the breadth of a student's comprehension of fundamental facts and principles that apply in their major field of study. It will also determine the student's ability to think critically about the theoretical and practical aspects of the field. Accordingly, the examination should be focused on the student's field of research but may and should venture into other areas of scholarship that underlie or impinge on the thesis topic. The topical scope of this examination should be recorded in the qualifying exam application.

By the end of the second year, the student will meet with the faculty committee for a pre-qualifying evaluation. At this meeting the student will give an oral presentation prepared for the qualifying exam and receive feedback and suggested corrections for improvement and to aid in their preparation for the research proposal and qualifying exam.

At least two weeks before the qualifying exam, the student will provide to the faculty committee a written document that describes their research topic, summarizes progress to date, and outlines what they propose 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 advisor and committee. The committee will review this document with the student 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.

8. Qualifying Examination:

The examination committee is the same as the student's faculty committee. The graduate advisor is a voting member of the committee but will normally not participate in the examination except to provide technical clarifications as requested by the other members of the committee.

The committee will submit the results of the examination to the Graduate Division.

The committee members should include in their deliberations 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. A unanimous decision is required for a "Pass". If not all members of the committee vote to pass, they must write a report explaining their decision and must inform the student of the reasons for the decision. A student who has not passed 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 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. Upon successful completion of the examination, the student submits an application for advancement to candidacy 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.

The deadline for passing the qualifying exam is the end of the third year. If a student cannot pass the qualifying exam by the deadline, the student is subject to disqualification from further study for the doctoral degree, even if the student has not met the requirements of the Master's degree. A student may consult with the candidacy committee and exit with a Master's degree after fulfilling the requirements of the Master's degree before the end of the third year. The student may petition the Graduate Group Chair with a reasonable account of the delay and a plan for passing the qualifying exam by a specific date.

Masters-in-passing: All Physics doctoral students who complete Master's degree requirements, including coursework, are eligible for a Masters degree on successful completion of their qualifying exam. This application must be made to the Graduate Division any time after the qualifying Exam is successfully completed. Contact the Graduate Coordinator for assistance with the process and the Master's degree requirements.

9. Dissertation:

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 final confirmation of the quality of a PhD 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 PhD will ultimately be determined by the student's advisor and thesis committee. The process of writing journal articles will be undertaken with the assistance and guidance of the student's research adviser. Published work should be presented to the graduate committee at the time of the student's thesis defense. The work must be the student's, and it must be original and defensible. The student is encouraged to discuss with members of the faculty 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 office.

The student must provide a copy of the dissertation to each member of the faculty 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 is 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 (although minor errors or matters of controversy may still exist), the final examination date may be scheduled by the student in consultation with the committee.

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. At the conclusion of the examination, the committee shall vote on 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. Unanimous consensus of the examination committee 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 the graduate advisor, who will be responsible for approving the final version of the dissertation that is submitted to Graduate Division.

10. Normative Time to Degree:

The Physics Graduate Group places no strict limits on the length of time a graduate student may remain in residence. However, it is normally expected that successful completion of the Ph.D. will require no more than six years. In order to ensure satisfactory progress toward the degree, each student must meet with their faculty committee for an annual review of progress at a mutually agreeable time. At least three members of the committee, including the graduate advisor, must be present. The committee will review the student's progress toward the degree during the past year and develop a timetable, mutually agreeable among student, graduate advisor, and faculty committee, for completion of the remaining requirements. The annual report of the committee will become part of the student's record. Should the committee conclude that the student is not making satisfactory progress toward the degree, the student may be placed on academic probation. This requirement of annual meetings with the committee necessitates that students identify and sign on with a particular graduate advisor and form a faculty committee before the start of their second year and advance to candidacy by the end of their third year.

11. Typical Timeline and Sequence of Events:

A sample timeline for the first 4 semesters of courses for a PhD student is shown below.

Fall 1	**Spring 1**	**Fall 2**	**Spring 2**
PHYS 210 C (4) Electrodynamics and Optics I	PHYS 237 C (4) Quantum Mechanics I	PHYS 241 (4) Condensed Matter Physics	PHYS 242 (4) Adv. Condensed Matter Physics
PHYS 205 C (4) Classical Mechanics	PHYS 212 C (4) Statistical Mechanics	QSB 294 (1) Responsible Conduct of Research	
PHYS 295 (1) Graduate Research	PHYS 295 (3) Graduate Research	PHYS 295 (6) Graduate Research	PHYS 295 (7) Graduate Research
PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium	PHYS 293 (1) Physics Colloquium
PHYS 251 (1) Introduction to Graduate Research			
PHYS 202 (1) Foundations of Physics			

C = core class, parentheses indicate units.

Typical activities through years 1-6 are shown below:

Year/semester	**Activities**
Year 1 (semesters 1, 2)	Perform rotations with assigned mentors Take classes Pass required review course PHYS 202 Pick PhD advisor by end of first year
Summer 1	Begin full time research with PhD advisor Assemble faculty committee before the start of second year

Year 2 (Semesters 3, 4)	Continue full time research with PhD advisor Take one class per semester if necessary Prepare for qualifying exam Complete the pre-qual evaluation (by the end of the second year)
Years 3, 4 (semesters 5-8)	Pass qualifying exam (before the end of the third year) Apply for candidacy Conduct research Prepare manuscripts for publication Present work at a scientific conference; network for career
Year 5, 6 (semesters 9-12)	Conduct research Prepare manuscripts for publication Present work at a scientific conference; network for career Defend and submit dissertation (last semester)

12. Sources of Funding:

Graduate students who received a funding offer with their admissions offer will have their financial support according to the terms of the funding offer. Funding will come through a combination of Teaching Assistantships, graduate Research Assistantships, and/or Fellowships. Master's students are typically not expected to be funded by such means; but they may receive a funding offer with their admissions offer. More information on financial support can be found in the Graduate Policies and Procedures Handbook.

13. Leaving the Program Prior to Completion of the PhD Requirements:

A student admitted for the Ph.D. degree in Physics, who, in the judgment of the faculty 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 Dean of Graduate Education. In some cases, a doctoral student may choose to leave the program with a master's degree only. It is the responsibility of the Graduate Group unit 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 their degree objective changed officially from doctorate to master's.

D. General Information

1) ELP, In Absentia and Filing Fee status.

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

E. List of courses

See the physics course catalog for the complete list.