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 Vice Provost and Dean of Graduate Education makes final decisions on admission. The deadline for receipt of applications is January 15 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;
- An official Graduate Record Exam (GRE) score report.; Both general and the subject test in physics are required.
- 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) if the applicant's native language or language of instruction is other than English.

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. Performance on the GRE, 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. Foreign students from non-English speaking countries are required to attain a minimum score on the TOEFL or IETLS exam as required by UC Merced policy for admission to graduate programs.

3) **General Committees**: All committee members will serve a three-year term, unless there are exceptional circumstances. 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.

Executive Committee

The Executive Committee shall determine and implement policy for the good of the Group and represent the interests of the Group to the University and other agencies. The Executive Committee will consist of three members who will serve rotating terms of three years. The Group chair will serve as an *ex officio* member of the Committee. It will be the responsibility of the Executive Committee to prepare an annual slate of nominees that will be put before the

membership for election to serve on the Executive Committee The Executive Committee will make appointments to the standing committees from the membership of the group.

Membership Committee

The Membership Committee shall consist of three members appointed by the Chair of the Graduate Group. The Membership Committee will be responsible for reviewing applications from faculty who wish to be part of the Group as affiliate members. In addition, the Committee will review the membership of all affiliate members of the Group every three years. Members of the Membership Committee will excuse themselves while their own cases are being reviewed.

Educational Policy Committee (EPC)

The Committee on Educational Policy shall consist of the chair of the Group, and two additional faculty. Membership on this committee is limited to Physics faculty at UC Merced. The EPC is responsible for establishing and guiding the educational programs of the Group. The EPC in consultation with the group faculty will determine changes in coursework, exam, and teaching requirements for students in the Group. The EPC will periodically conduct reviews of the program and will oversee the self-study associated with formal program reviews.

Admissions Committee

The Admissions Committee is charged with the development of recruiting materials for the Group, reviewing applications for admissions, and exploring graduate student support mechanisms. The Admissions Committee shall consist of the chair of the Group, and at least two additional members, one of who will serve as the Graduate Admissions Chair.

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 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 (12 units minimum) at UC Merced;
- Pass the preliminary examination;
- Complete at least 30 units of upper-division and graduate course work with a cumulative grade-point average of at least 3.0. At least 24 units must be from graduate-level courses in the 200 series, while the remaining 6 units may be research or similar courses; 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;

- In addition, the M.S. program requires attendance at physics seminars 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*:** In accordance with SR 682 and 686, the minimum residency requirement for any advanced degree is two semesters. M.S. students must be registered as a full- time student for at least one semester before advancement to candidacy. M.S. students must be in residency for at least one semester after advancement to candidacy before conferral of the degree. For the purposes of determining 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. Students must be enrolled in at least 12 semester units to be considered full time. Exceptions will only be granted for students in the Masters 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 his or her 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 dismissed from the graduate program.

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 group are required to take:**

A. Core Course Requirements:

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 or Masters
1) A physics elective from this list

- PHYS 204: Biophysics
- PHYS 209: Soft Matter Physics
- PHYS 280: Nonlinear Dynamics
- PHYS 248: Quantum Optics
- PHYS 241: Condensed Matter Physics
- PHYS 242: Advanced Condensed Matter Physics
- PHYS 244: Modern atomic, molecular and optical Physics

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. All physics courses are listed at the end of this document (pg 20-23).

We require at least one elective be a course outside the student's primary research area for Ph.D students, which can be selected by discussion with the student's graduate advisor or the graduate group chair for Physics.

C. Additional courses: Students must take 1 unit of QSB 294 Responsible Conduct of Research, 4 semesters of Physics seminar, 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.

***Waivers*:** If a student would like to attain a waiver for any of the courses above, the rules are:

1. No waiver will be granted unless the student has passed the preliminary exam.
2. For waivers regarding elective courses, a student can only ask for a waiver on one elective course. All core courses can be waived if competency is demonstrated.
3. For a waiver on any of the courses, the student will need to attain the waiver from the faculty member who taught the course most recently. The faculty member granting the waiver will only do so if the student can successfully complete an exam in the course. This exam can be given at any time at the faculty and student's convenience, any time of the year. The final decision to grant the waiver will be taken by the Graduate Division.

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. 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 graduate advisor. All Physics graduate students must successfully complete their core course requirements with a grade of S or B or better. A student may petition the graduate chair for a single B- grade to be accepted. 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, and per UC regulations students shall ordinarily not receive credits for more than 12 units of graduate level courses (200) per 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. All students in the group are required to pass a written preliminary examination that tests undergraduate-level understanding of the fundamental concepts in the field. This exam is administered twice each year, at the beginning of the fall and spring semesters. The exam consists of three papers – Classical Mechanics, Quantum Mechanics and Electromagnetism. The exam may be taken once each time it is offered but must be passed no later than the end of the second year. Students need to pass each paper individually but not necessarily at the same time. Students who have not passed the exam by the end of the second year may be subject to dismissal.

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*:** 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 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 taken to the Graduate Division. The deadlines for completing this requirement are listed each semester in the Graduate Division website. The committee must report to the Graduate Council via the Vice Provost and Dean of Graduate Education within 30 days.

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 assists students with identifying appointments and general university policies. Mentoring practices are consistent with UCM Mentoring guidelines.

3) Master's Degree Committees:
***Comprehensive Examination Committee*:** The student, in consultation with his/her graduate advisor and graduate group chair, nominate three faculty (including the advisor) to serve on the Comprehensive Examination Committee. These nominations are submitted to the Graduate Division for formal appointment in accordance with Graduate Council policy. This committee of three faculty members shall approve the subject, pass on the content of examination, and administer the examination. Usually one of the committee members directs the examination

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

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	PHYS237 C (4) Quantum Mechanics I	PHYS241 (4) Condensed Matter Physics	PHYS242 (4) Condensed Matter Physics
PHYS 205 C (4) Classical Mechanics	PHYS 212 C (4) Statistical Mechanics	QSB294 (1) (Responsible Research)	
PHYS 295 (2) (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
Pass Preliminary Exam			

6) Sources of Funding: Students for the masters degree do not have a funding guarantee. They may be self-financing or may receive support as teaching assistants if positions are available.

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 presented a doctoral dissertation containing an original contribution to knowledge in his or her chosen field of study.

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

- Complete at least four semesters of full-time academic residence (12 units minimum) 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 preliminary examination;
- Pass the Ph.D. qualifying examination;
- Present and successfully defend a doctoral dissertation containing an original contribution to knowledge in the field.

Residency: In accordance with SR 682 and 686, the minimum residency requirement for any advanced degree is two semesters. The minimum residency requirement for the Ph.D. degree is four semesters. Before advancement to candidacy Ph.D. students must be registered in regular University courses as a full-time student for at least two semesters. For the purposes of determining residency, only the Fall and Spring semester will be counted; however, the summer semester may be counted in evaluating students on academic probation. Residency is established by satisfactory completion of at least 4 units of graduate coursework (including research) per semester. Full-time residency requires enrollment in at least 12 units. Ordinarily, a graduate student shall not receive credit for more than 12 units of graduate courses in any semester. The physics graduate group only accepts full time students.

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 his or her 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.

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 three grade points per unit 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 group are required to take:

A. Core Course Requirements:

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) A physics elective from this list

- PHYS 204: Biophysics
- PHYS 209: Soft Matter Physics
- PHYS 280: Nonlinear Dynamics
- PHYS 248: Quantum Optics
- PHYS 241: Condensed Matter Physics
- PHYS 242: Advanced Condensed Matter Physics

- PHYS 244: Modern atomic, molecular and optical Physics

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. All physics courses are listed at the end of this document (pg 20-23).

We require at least one elective be a course outside the student's primary research area for Ph.D students, which can be selected by discussion with the student's graduate advisor or the graduate group chair for Physics.

C. Additional courses:

In addition, students must take 1 unit of QSB294 Responsible Conduct of Research, 4 semesters of Physics seminar, 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. Some Physics Graduate Level Courses are listed in the following table. Most up-to-date list is in the Course Catalog.

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 of the courses above, the rules are:

1. No waiver will be granted unless the student has passed the preliminary exam.

2. For waivers regarding elective courses, a student can only ask for a waiver on one elective course. All core courses can be waived if competency is demonstrated.

3. For a waiver on any of the courses, the student will need to attain the waiver from the faculty member who taught the course most recently. The faculty member granting the waiver will only do so if the student can successfully complete an exam in the course. This exam can be given at any time at the faculty and student's convenience, any time of the year. The final decision to grant the waiver will be taken by the Graduate Division.

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. 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 graduate advisor.

All Physics graduate students must successfully complete their core course requirements with a grade of S or B or better. A student may petition the graduate chair for a single B- grade to be accepted. 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, and per UC regulations students cannot receive credits for more than 12 units of graduate level courses (200) per semester.

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, although the 12 units per semester are generally fulfilled with a research (PHYS 295).

3. 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 4 semesters of Physics seminar, 1 unit of QSB294 Responsible Conduct of Research, and 1 unit of PHYS 251 Introduction to Graduate Research.

All students in the group are required to pass a written preliminary examination that tests undergraduate-level understanding of the fundamental concepts in the field. This exam is administered twice each year, at the beginning of the fall and spring semesters. The exam consists of three papers – Classical Mechanics, Quantum Mechanics and Electromagnetism. The exam may be taken once each time it is offered, but must be passed no later than the end of the second year. Students need to pass each paper individually but not necessarily at the same time. Students who have not passed the exam by the end of their second year may be 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.

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 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. For this assignment only Physics faculty (https://physics.ucmerced.edu/people#Faculty) will be considered, not 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

(https://physics.ucmerced.edu/people#Affiliate%20Faculty). 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 expected to choose one of the two mentors as their graduate research advisor. In the case that a faculty member is paying a student during the first year as a graduate student researcher, the rotation requirement will be waived.

To ensure all students have adequate time to select an advisor, each student will meet with the graduate group chair right after spring break. In case neither mentors are willing or able to become an advisor, the student will then be assigned a third mentor of his/her choice.

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.

Individual Development Plan (IDP): Once the student selects a PhD advisor , he/she will prepare an IDP (http://myidp.sciencecareers.org/) 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 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 his or her achievements over the last year. The comments from the committee will be incorporated into the IDP by the advisor and a copy submitted via email to the SNS graduate program coordinator with CC to the graduate group chair.

Advanced degree committees in the Physics group shall consist of at least three members. One must be the student's Physics graduate advisor, one other must be a Physics 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 group. This outside member 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. In this case, the graduate 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 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 reason must be acceptable to 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 take and pass the qualifying examination before the end of their third year of graduate study unless they successfully petition the Graduate Group Chair to take it at a specific later date. The qualifying examination may not be scheduled until the preliminary examination 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 his or her 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 scope of this examination should be communicated to student by the committee chair at least two months in advance of the exam date.

At least 4 weeks before the tentative qualifying exam date, the student will meet with the faculty committee for a pre-qual 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 his/her preparation.

At least two weeks before the qualifying exam, the student will provide to the faculty 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 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 immediately submit the results of the examination to 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 is given an application for advancement to candidacy by the examining committee chair. When it is filled out and signed by the graduate advisor and graduate group chair, the student pays a candidacy fee and submits the form to 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.

Masters-in-passing: All Physics graduate students 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.

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 date must be reported to the Vice Provost and Dean of Graduate Education, and one copy of the dissertation filed, no later than three weeks before the proposed date of the final examination.

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. A 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 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 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 his or her 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 during 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	QSB294 (1) (Responsible Conduct of Research)	
PHYS 295 (2) 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			

C = core class, brackets indicate units.

Typical activities through years 1-5 are shown below:

Year/semester	Activities
Year 1 (semesters 1. 2)	Perform rotations with assigned mentors Take classes Pass preliminary exam Pick PhD advisor by end of second semester
Summer 1	Begin full time research with PhD advisor
Year 2 (Semesters 3, 4)	Continue full time research with PhD advisor Take one class per semester if necessary Assemble faculty committee (beginning of third semester) Prepare for qualifying exam Schedule qualifying exam (during fourth semester) Apply for candidacy after passing qualifying exam (end of fourth semester)
Years 3, 4 (semesters 5-8)	Conduct research Prepare manuscripts for publication Present work at a scientific conference; network for career
Year 5 (semesters 9, 10)	Conduct research Present work at a scientific conference; network for career Declare candidacy for graduation (ninth semester) Defend and publish dissertation (tenth semester)

12. Sources of Funding:

Newly admitted students will normally be supported as graduate TAs during their first two semesters in residence, with Ph.D students being prioritized. After that, students will be supported as either TAs or GSRs depending on availability of TAships and the research advisor's funding situation.

New students who cannot be appointed as TAs because of limited English proficiency or lack of available TA positions may be appointed as GSRs for their first one or two semesters by mutual agreement of the student and the research advisor. Normally all students will be required to TA for at least one semester as long as a suitable TA position is available. TA experience at other institutions could satisfy this requirement.

Graduate students serving as GSRs during the academic year will be appointed at 49.9% at the step for which the monthly stipend is most nearly equal to that for a first year TA in the Natural Sciences. There will be no additional or reduced pay during break periods.

Graduate students serving as GSRs during the summer will be appointed at the step determined above. The appointment will be 60% for students who have not yet been advanced to candidacy for the Ph.D. degree, and 70% for those who have been advanced to candidacy. Students are expected to spend the remainder of their time pursuing independent study toward the degree. GSRs do not accrue paid vacation time.

Students are also encouraged to make use of other sources of funding including Physics Summer Fellowships, campus-wide fellowships provided by the Graduate Division as well as extra-mural funding opportunities from both federal, state and private sources. Lists of these are available on the Graduate Division website.

Non-resident Ph.D. students who have advanced to candidacy are eligible for a waiver of their NRST for a maximum of three consecutive calendar years. Waiver begins with the first academic term following completion of all requirements (including submission of all forms) for advancement to candidacy. Any non-resident student who continues to be registered, or who re-registers following the three-year maximum allowance, will be charged the full NRST rate that is in effect at that time.

Exceptions to these policies may be made at the recommendation of the student's research advisor, the graduate group chair, and the graduate dean.

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

A student admitted for the Ph.D. degree, which, in the judgment of the unit's graduate affairs committee should not continue past the master's degree, must be notified in writing by the Graduate Group Chair of the Graduate Group offering the degree. 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 his/her 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:

Course number	Title, [units]	Description
PHYS 204	Biophysics [4]	Aims to give students an understanding of relevant physical principles for biological systems, introduce them to experimental and theoretical techniques of biophysics and to communicate the excitement of cutting-edge biophysics research. Topics include diffusion, fluids, entropic force, motor proteins, enzymes, nerve impulses, networks and evolution
PHYS 205 (Core)	Classical Mechanics [4]	Topics in classical mechanics, including Lagrangian and Hamiltonian formulations, Conservation Laws and Symmetry and the relationship, Calculus of variations and variational principle, Euler angles and rigid body dynamics, Oscillations and normal modes.
PHYS 210 (Core)	Electrodynamics and Optics I [4]	Introduction to electrodynamics. Electrostatics including Poisson and Laplace Equations, Green's Theorem and different Boundary Value Problems, Polarizibility, Susceptibility and dielectric media. Magnetostatics, Maxwell's equations, Plane Electromagnetic Waves, Polarization of light, Electromagnetic radiation in different media.
PHYS 211	Electrodynamics and Optics II [4]	Continuation of electrodynamics. Wave guides and resonant cavities, Multipole radiation, Relativistic charged particles in electromagnetic fields, Collisions between charged particles and radiation from moving charges with relativistic corrections, introductory magnetohydrodynamics.
PHYS 212 (Core)	Statistical Mechanics [4]	Topics include: General principles of statistical mechanics including microcanonical, macrocanonical and grand canonical ensembles, fluctuations and equilibrium. Thermodynamics including Legendre transforms and Maxwell relations, fluctuations and stability and Landau theory. Quantum statistical mechanics including Bose-Einstein and Fermi-Dirac statistics.
PHYS 237 (Core)	Quantum Mechanics I [4]	Introductory Quantum Mechanics starting with simple Quantum two-state systems and one dimensional problems, Uncertainty relations, Solution of Schrodinger's equation for important two and three dimensional physical situations, Angular momentum, identical particles and spin statistics. Hydrogen and multi-electron atoms.

PHYS 230	Computation and Modeling for Interdisciplinary Biophysical Sciences, Biomaterials and Biotechnology	Covers cutting-edge applications of computation and modeling tools to problems in biophysical sciences, biomaterials and biotechnology. Team of students will undertake open research projects utilizing tools and languages such as R, Python and C/C++ to address questions ranging from epidemic spreading to protein desi
PHYS 231	Imaging and Spectroscopy for Interdisciplinary Biophysical Sciences, Biomaterials and Biotechnology	Covers cutting-edge applications of imaging and spectroscopy tools to problems in biophysical sciences, biomaterials and biotechnology. Teams of students will undertake open research projects utilizing tools such as protein expression and purification, single molecule, nuclear magnetic resonance and mass spectroscopy to understand the structure and dynamics of biomolecules.
PHYS 232	Bio and Nano Fabrication for Interdisciplinary Biophysical Sciences, Biomaterials and Biotechnology	Covers cutting-edge applications of fabrication tools to problems in biophysical sciences, biomaterials and biotechnology. Teams of students will undertake open research projects utilizing tools such as lithography, electrospinning, cell culture and confocal microscopy to explore cellular and multicellular systems
PHYS 241	Condensed Matter Physics [4]	An introduction to the physics of materials designed for graduate students in physics or chemistry. The course will cover traditional solid state physics and examine the relationship between microscopic structure and bulk properties in different materials.
PHYS 242	Advanced Condensed Matter Physics	Topics include elementary excitations and quasiparticles, bandstructure of electrons and photons, optical and dielectric properties, symmetry and group theory for solids, simulation techniques for electronic structure, and electrical and thermal transport
PHYS 244	Modern Atomic, Molecular, and Optical Physics	Covers modern topics in the atomic, molecular, and optical (AMO) physics. The interaction of atoms with radiation, laser cooling and trapping, Bose-Einstein condensation, atom interferometry, and ion trap quantum computing. Quantitative understanding of the physics effects is required for graduate students.

PHYS 248	Quantum Optics [3]	Covers the quantum nature of light, atom-light interaction and experimental quantum optics. It will provide a basis for research in the field of quantum optics. Fundamental concepts and techniques will be linked to modern experimental research.
PHYS 249	Quantum field theory [4]	An introduction to quantum field theory with a special emphasis on quantum electrodynamics (QED). Topics include canonical quantization of scalar fields, electromagnetic fields, perturbation theory and renormalization methods among others.
PHYS 280	Non-linear dynamics [4]	Most processes encountered in nature are inherently nonlinear. This course introduces the main topics of low-dimensional nonlinear systems, with applications to a wide variety of disciplines, including physics, engineering, mathematics, chemistry, and biology. Specific topics include maps and flows in one and two dimensions, phase portraits, bifurcations, chaos, and fractals.
PHYS 209	Soft Matter Physics [4]	Introduction to the physics of soft materials designed for graduate students in physics. Uses a physics based approach to study the structure and assembly of a variety of materials including liquid crystals, polymers, colloidal systems and surfactants including biological examples.
PHYS 292	Special Topics in Physics [1-4]	Treatment of a special topic or theme in Physics at the graduate level. May be repeated for credit. Laboratory included.
PHYS 244	Modern AMO Physics [4]	This covers modern topics in Atomic, Molecular, and Optical (AMO) Physics, such as the interaction of atoms with radiation, laser cooling and trapping, Bose-Einstein condensation, atomic interferometry, ion traps, and quantum computing.
PHYS 293	Physics Colloquium [1]	This is a colloquium series with talks on a wide range of research topics in Physics. Speakers for the colloquia are primarily invited researchers from other Institutions. Some of the seminars additionally showcase the research performed by UC Merced Physics faculty, post doctoral researchers and graduate students. This is a forum to introduce the undergraduate and graduate students to cutting edge research in Physics conducted on-site and elsewhere, and to give them an opportunity to meet researchers and faculty from other Universities/Research Institutions.

PHYS 295	Graduate Research [1 - 15]	Supervised research. Permission of instructor required. S/U grading only.
PHYS 298	Directed Group Study [1 - 6]	Group project under faculty supervision. Permission of instructor required. S/U grading only.
PHYS 299	Directed Independent Study [1 - 6]	Independent project under faculty supervision. Permission of instructor required. S/U grading only.