

GRADUATE STUDENT HANDBOOK

**Department of Physics
IUPUI**

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Admission and Termination

Admission and Termination decisions at IUPUI will be made by the IUPUI Graduate Committee subject to the Departmental policies of IUPUI Physics Department and the applicable rules and regulations of the Purdue Graduate School.

Degrees Offered

Master of Science degrees awarded by the Department are Indiana University graduate degrees. Doctor of Philosophy degrees awarded by the Department are Purdue University graduate degrees. All of the procedures are approved through both the Indiana University & Purdue University Graduate School.

Master of Science

The Department of Physics offers a Master of Science degree with two options:

Non-Thesis Option

Non-thesis students complete a research project under the supervision of a faculty advisor and write a project report. A final examination is required.

Thesis Option

In the thesis option the student completes a research project under the supervision of a faculty advisor, and writes a thesis that must meet formal formatting rules specified by the Graduate School. A final examination (thesis defense) is required.

Doctor of Philosophy

The student completes a substantial research project under the supervision of a faculty advisor. A thesis is submitted to the Graduate School and the student must defend the work in a public presentation followed by a meeting with the student's graduate advisory committee. The thesis is preceded by successful performance of the student in a preliminary examination.

Qualifying Exam

All physics graduate students are required to pass the graduate qualifying examination at the level appropriate for the given degree.

At the PhD level, the examination is a written examination composed and graded by the Indiana University-Purdue University Indianapolis Department of Physics. The examination will be physically given at IUPUI and supervised and graded by IUPUI Physics faculty. Students are allowed two attempts to pass the exam, plus an optional attempt before starting our program at IUPUI.

The qualifying exam is given twice a year, shortly before classes begin in the Fall and the Spring semesters. The examination consists of two, 3-hour parts given on successive days. There are eight problems in each part.

The IUPUI Physics Department Graduate Committee sets passing scores on the exam. Traditionally the Ph. D. pass is around 50%.

This examination requires a knowledge of classical mechanics at the level of the texts by Fowles, *Analytical Mechanics*, and Marion and Thornton, *Classical Dynamics of Particles and Systems*; of electricity and magnetism as presented in Griffiths, *Introduction to Electrodynamics* and Reitz, Milford and Christy, *Foundations of Electromagnetic Theory* and Marion, *Classical Electromagnetic Radiation*; of quantum physics at the level of French and Taylor, *An Introduction to Quantum Physics* and Eisberg and Resnick, *Quantum Physics of atoms, molecules, solids, nuclei, and particles*; and of Thermal physics as found in Kittel and Kroemer, *Thermal Physics*. Finally a general knowledge of modern physics at the level of the texts by Weidner and Sells, Krane, Sandin, Serway and Tipler is required.

New students are encouraged to take the exam at the first opportunity upon arrival at IUPUI before taking any classes to become familiar with the exam and for the Department to assess their standing. This attempt is not counted against the two attempts provided the student has no graduate degrees in physics from U. S. institutions. Students must take the exam after completing nine (9) hours of graduate courses. If the exam is failed, it must be taken again at the next time it is given (Exceptions may be made in extenuating circumstances). Those entering the program with a graduate degree in physics from an institution in the U. S. are permitted only one further attempt beyond the one taken before the first semester of enrollment. The further attempt must be no later than the beginning of their second semester of study in the Department.

Copies of exams given previously may be obtained from the Graduate Secretary.

For terminal M. S. degree only, the qualifying examination consists in passing the core physics classes (PHYS 51000, PHYS 51700, PHYS 53000 and PHYS 55000) with a 3 point average and no grades below B-. When appropriate, the 500 level courses can be changed by a 600 level equivalent one.

Qualifications for Financial Support

The Department provides support to some graduate students through Dean's Fellowships, University Fellowships, Departmental Fellowships, Teaching Assistantships, Research Assistantships, Fee Scholarships, and partial Fee Remissions. Various rules apply to these funding sources. Of particular note:

- Masters students may receive support as Teaching Assistants for a maximum of three regular semesters unless they pass the Qualifying Examination at the Ph. D. level and are continuing for a Ph. D. degree.
- TA's should maintain a 3.0 grade average.
- Fellowship students are expected to carry a heavier load of courses and/or research than TA's.
- It may not be possible for the Department to pay tuition for hours in excess of the minimum required for graduation.
- It is the policy of the department that graduate students who are fully supported by the department may not hold outside employment.
- Full-time M. S. students are expected to finish the degree requirements in three semesters, not including Summer sessions.
- Fee remission is applicable only to those courses that meet the requirements of the degree program or that may be included on a Plan of Study.
- In order to be considered full time, student must enroll in a minimum of 8 credit hours every semester. This status ensures you are eligible for health care, student visas, and deferments for student loans.

Master of Science Degree

Master's Degree Requirements

Summary of requirements:

1. Satisfactory completion of 30 credit hours of approved graduate work.
2. An approved Plan of Study.
3. An approved thesis or project report.
4. A satisfactory performance on a thesis defense or project presentation.
5. A satisfactory attendance record at Department seminars.

There is a thesis option and a non-thesis option for this degree. The options are nearly identical. A formal thesis must be written in the former case based upon research work. Non-thesis students will complete a research project, prepare and defend a report on the work. Students are encouraged to pursue the non-thesis option.

Selection of Advisor and Advisory Committee

During the second semester the student is required to select a graduate advisor. Fellowship students are expected to make this selection after one semester. Registration for the third semester is dependent upon having selected this advisor. The advisor is the primary person responsible for directing the student's thesis research or non-thesis project and determining appropriate courses to be taken. Students should talk with a minimum of four Department faculty about their areas of interest and possible research projects before choosing an advisor. A list of faculty research specialties appears later in this handbook. The selection of the advisor will be by mutual consent between the faculty member and the student. Once the student has selected an advisor, the Director of the Graduate Program should be informed.

After selecting an advisor, the student and advisor will choose an Advisory Committee. The same rules for the number, composition and other rules relating to the M. S. advisory committee apply at IUPUI as at Purdue except that none of the members need be from Purdue, West Lafayette. The functions of the Advisory Committee are to approve the courses listed in the Plan of Study, and to serve as the examining committee for examinations such as the "Thesis Defense".

An Advisory Committee consists of a minimum of three persons chosen from the Department faculty, including the student's advisor who is Chairman of the Committee. Additional members may be appointed to the Advisory Committee from faculty in another department appropriate to the student's research program.

Course Requirements

Both options require the completion of 30 credit hours of graduate study. The required distribution of courses is outlined below. During the first year, the student will generally take courses that meet the Mathematics and core Physics requirements. Students should choose an advisor as soon as possible but no later than the end of the second semester. The student must also select an advisory committee, consisting of the advisor and two other faculty members in the Department. The student will work with this group to develop a Plan of Study for the remainder of the Master's program. Courses taken should reflect a coherent theme of interest.

The credit hour requirements are to be fulfilled:

18 hours of formal (non-research) Physics graduate acceptable courses:

- 51000 Physical Mechanics
- 51700 Thermodynamics and Statistical Mechanics
- 52200 Coherent Optics and Quantum Electronics
- 53000 Electricity and Magnetism
- 53300 Magnetic Resonance
- 54500 Solid State Physics
- 55600 Nuclear Physics
- 55000 Introduction to Quantum Mechanics
- 57000 Special Topics
- 58500 Introduction to Molecular Biophysics
- Any physics 60000-level formal course.

6 hours of Mathematics at the 500 or 600 level:

Physics 60000 and/or 60100 may be substituted for these courses.

6 hours of Research:

For students in the Thesis Option at least 3 credit hours must come from Physics 69800, M. S. thesis research. Physics 59000 (Reading and Research) may be used for the other 3 hours. For the non-thesis option all 6 hours should be Physics 59000. (When in doubt as to thesis or non-thesis project, use 59000.)

6 hours of the physics courses noted above may be substituted by graduate courses in other disciplines approved by the student's advisory committee. Such courses could be in Biology, Biochemistry, Chemistry, Engineering, Informatics, Mathematics, Physiology and Biophysics, or other appropriate disciplines. Examples of acceptable substitute courses are:

- B50000 Introduction to Biochemistry (Biochem)
- Chem 53300 Introduction to Biochemistry (Chem)
- ME 55100 Finite Element Analysis (ME)
- Biol 57000 Biological Membranes (Biol)
- Chem 57500 Intermediate Physical Chemistry (Chem)
- Physiol F592 Principles of Biomedical Imaging (Biophys)
- Physiol F650 Membrane Biophysics (Biophys)

Grade Requirements

The cumulative Grade Point Average for all courses taken must be 2.8 or higher on a 4.0 scale. The following additional grade requirements apply to courses used to meet the specific requirements listed above: Grades for physics courses at the 50000 level must be B- or above, and the grades in 60000 level physics courses must be C- or above. In both 50000 and 60000 level mathematics courses, C- or above are satisfactory grades. Courses from other departments used as an approved substitute for a physics course must meet the corresponding physics course grade requirement.

Credit Transfer

A maximum of 12 credit hours of courses may be transferred into the program. Those courses must be at the graduate level and can be from another institution or from IUPUI.

Plan of Study

The student and advisor will cooperate in the preparations of the Plan of Study for the M. S. degree. The completed Plan of Study must reach the West Lafayette Graduate School Office by the end of the semester preceding the semester in which the degree is to be awarded. Allow a few weeks for approval and transmittal through the system. The student is encouraged to file the Plan of Study earlier if possible. Note, however, that the Plan of Study cannot be officially filed until the English requirement is met. In cases where meeting the English requirement is delayed, an informal Plan of Study should be worked out by the student and Advisor to guide the student's course work. Minor changes may be made to the Plan of Study by submitting the form "Request for Change to the Plan of Study". Major changes in the Plan of Study require resubmission of the Plan of Study.

Thesis

Students will complete a research project under the supervision of a faculty advisor selected from members of the physics faculty. This work must be written up as a master's thesis in an official format specified by Purdue University. Current format rules may be obtained from the Chairman of the Graduate Committee.

There are specific deadlines each semester for a "Format Check" of the thesis and for "Final Submission" of the thesis that usually come two weeks before and on the last day of the semester respectively. Failure to meet these deadlines will delay graduation by a semester. Check with your advisor for the date of the appropriate deadlines.

Copies of previous physics masters theses may be examined in the Department office. They are typically 30-50 pages in length.

There is a final thesis defense at which the student describes the research and answers questions from an examining committee and a general audience. The examining committee normally consists of the student's Advisory Committee. If the Examining Committee differs from the Plan of Study Committee, a "Request for Appointment of Examining Committee" form must be submitted at least two weeks ahead of time listing the revised Committee. Upon satisfactory completion of this exam, the Advisory Committee must file the official Purdue form entitled "Report of the Examining Committee" with the Purdue Graduate School.

Non-Thesis Option

Non-thesis students may work with any member of the Department who can provide the student with a project. Projects may be traditional research projects, typically of lesser scope than a thesis projects, or of some other nature such as working with a faculty member in the development of physics resource materials.

A Project Report is required upon completion of the project, and must be submitted to the student's Advisory Committee for approval. A duplicate copy is to be filed with the Chairman of the Graduate Committee. Typically the reports are 15 to 30 pages long. Examples may be found in the Department office.

There will be a final examination much like that held for a thesis student. The student's Advisory Committee will determine the format of the examination. Upon completion of this step the Advisory Committee must file the official Purdue form entitled "Report of the Examining Committee" with the Purdue Graduate School. If the Examining Committee differs from the Plan of Study Committee, a "Request for Appointment of Examining Committee" form must be submitted at least two weeks ahead of time listing the Committee members. As above, upon satisfactory completion of this exam, the Advisory Committee must file the official Purdue form entitled "Report of the Examining Committee" with the Purdue Graduate School.

Seminar Attendance Requirement

The Department has a regular program of seminars every semester which students are required to attend. The student's advisor and the Chairman of the Graduate Committee will monitor this attendance.

M. S.-Ph. D. Transition

Students may be approved for Ph. D. study upon enrollment at IUPUI or those registered in the IUPUI Physics Master's Program may continue for their Ph.D. at IUPUI. Requirements for Advancing to Ph.D. registration status for M. S. students are:

1. The Purdue Qualifying Exam must be passed at the Ph.D. level. This should be accomplished by the end of the third semester in residence (not counting summers). It is necessary to petition the Purdue WL Physics Graduate Committee if the exam is taken later than this.
2. The student must apply to the IUPUI Physics Graduate Committee for acceptance into our Ph.D. program and be accepted. Sometimes an official application will be required.

M. S. Check List

The student is responsible for seeing to it that all these requirements are met on time. If you leave it to someone else, your graduation could be delayed!!

1. Be formally accepted into program.
2. Meet Purdue University English requirement.
3. File "Plan of Study" no later than semester preceding graduation semester.
4. Enroll in zero credit hour Candidate 991 course in expected semester of graduation. If one does not graduate when expected, you must re-enroll in Cand 991.
5. Complete 30 acceptable graduate credit hours with necessary minimum grades as outlined above.
6. Begin thesis "format check" process at the beginning of the final semester and meet all subsequent deadlines. An official schedule is published each year. The IUPUI Graduate School Office (274-1577) is the final authority on these matters.
7. File an official "Request for Appointment of Examining Committee" with the Purdue Graduate School two weeks before the date of the exam. The 'Examining Committee' is generally the student's 'Advisory Committee'.
8. Schedule, hold, and pass a final examination. The 'Examining Committee' must file an official "Report of Master's Examining Committee" with the Purdue Graduate School before the end of the semester.
9. Assure that all "R" grades are removed (via the removal of "R" grade form).
10. Assure that the advisor signs off on the 'Candidate Audit Report'.
11. File a copy of the thesis or final research report with the Department.

Doctor of Philosophy Degree

Degree Requirements

Some of the important requirements are outlined below:

1. Pass the Purdue Qualifying Exam at the Ph.D. level
2. Gain acceptance to the IUPUI/Purdue Ph.D. program as outlined above and select a Ph.D. advisor
3. Establish a Ph.D. Committee. A formal “Plan of Study” should be filed as soon as possible, but not later than the semester prior to taking the Prelim exam.
4. Progress reports are to be completed annually. Students will meet with local advisory committee (i.e. the Advisory Committee without the West Lafayette representative) at least once a year to set research goals and review progress towards completion of the PhD thesis research.
5. Pass the Ph. D. Preliminary Examination based upon the research planned. Note that the Preliminary Examination must precede the final thesis defense by a minimum of one year. All the paperwork must be finished two weeks before the exam. The Preliminary Examination will count as a progress report for that year.
6. The student is required to take at least one course in his/her area of specialization. This course will be selected with the guidance of the student’s Ph.D. Committee.
7. A total of 90 credit hours (including MS work) are required. 60 credit hours are required for students who already have an M. S. degree from another institution in the United States.
8. As an integral part of the work toward the Ph.D. degree, the student is expected to attend the general departmental seminar regularly and special seminars in his/her specialty.
9. Once the core courses are mostly completed and the Qualifying Examination passed the student may be certified. This process is described in the Purdue University Graduate manual.
10. Complete a thesis based upon his/her research.
11. Present a departmental seminar over his/her research work.
12. A final oral examination over the thesis must be scheduled and passed as outlined in the Purdue manual.

Course Requirements

There is no requirement for a fixed number of course credit hours. However, there are four core courses that must be completed:

- Physics 61700, Statistical Mechanics
- Physics 63000, Advanced Theory of Electricity and Magnetism
- Physics 66000, Quantum Mechanics I
- Physics 66100, Quantum Mechanics II.

The student must take three additional specialty courses approved by the Graduate Committee. These in general would be relevant to the student’s area of interest. Additional courses may be taken based on the student’s background and needs.

Grade Requirements

The core courses must be completed with a minimum grade-point average of 3.00/4.00 (B average) for those courses taken here. The overall plan of study cannot contain any 500-level course with a grade less than B- and no 60000-level course with a grade less than C-. The grade requirements for courses taken in disciplines other than physics are the same.

Course Transfer

A core course need not be taken here if its equivalent has been taken previously at another institution. A student may request equivalency in a core course by providing evidence of completion of a comparable course with a grade equivalent to an A or B. Please see the Purdue University Physics graduate manual for details on how to establish course equivalence.

Certification

The student must be *certified* as meeting departmental standards in physics. The usual minimum requirements for certification are: (a) The Qualifying Examination has been passed at the Ph. D. level and (b) the core courses have been completed with a minimum grade-point average of 3.00/4.00 (B average) for those taken here. Normally, the Graduate Committee will recommend that the student be certified when the above conditions have been met. In the event that the student's grade-point average is lower than 3.00, the Graduate Committee will review all available evidence on the quality of the student's performance. For more details see the Purdue Physics Department Graduate Manual. Provided the student is advancing in their research work and other responsibilities, it is expected that certification will be attained.

Ph.D. Advisory Committee

The Committee will consist of a minimum of five members. The major professor (student's advisor) is Chairman of this committee. The student selects a second member of the committee. Two additional members should be chosen by the student, but must be approved by the Graduate Committee. These four members must be chosen to meet the following requirements: (i) one experimentalist, (ii) one theorist, and (iii) one person outside the student's research area (check with the Director of the Graduate Program for guidance on this point). One committee member must be from the Physics Department at West Lafayette.

In some cases it may be appropriate to choose a committee member who is not a member of the Purdue Graduate Faculty (or even of the University). The names of such persons first must be submitted to the IUPUI Department of Physics Graduate Committee for approval, and if approved, a formal request on the "Request for Graduate Faculty Certification" form must be submitted through the Physics Department at West Lafayette to the Purdue University Graduate School.

The Ph.D. Committee is responsible for guiding the student in his/her research and in maintaining Department standards and expectations for Ph.D. students. The Committee must meet a minimum of twice a year for the purpose of reviewing the student's progress.

Plan of Study

The Plan of Study for the Ph. D. degree should be filed as soon as feasible. The Plan of Study consists of a list of courses taken or to be taken by the student. The Plan of Study must be approved by the advisor and the student's Advisory Committee. It must be filed prior to scheduling the Preliminary Examination. Minor changes in the Plan of Study may be made to

the Plan of Study by submitting the form “Request for Change to the Plan of Study”. Major changes in the Plan of Study require resubmission of the Plan of Study.

Preliminary Examination

The Preliminary Examination should be scheduled within one year of the completion of the M.S. degree, but no later than one full year before the expected graduation date. The exam involves several steps:

1. The Ph.D. advisor, with the assistance of the student’s Ph.D. Committee, will advise the student on the content of the examination. Generally, it is expected that the content will address aspects of the student’s proposed Ph.D. research.
2. The student prepares a 10-25-page report on his/her proposed research and results obtained to date. The student will be expected to understand the significance of the research and be able to place it in a broad perspective.
3. The Ph.D. Advisory Committee will review the written report and schedule an oral examination to test the student’s preparedness to pursue Ph.D. studies.
4. Questions in the exam need not be restricted to specifics of the research area.
5. Based on the student’s course work, his/her research proposal, and the oral examination, the Advisory Committee will determine what further course and other work may be required to properly prepare the student for his/her research, thesis preparation, and thesis defense.

Thesis

The student’s research must be carried out in such a way as to meet the standards set by the major professor and other members of the Advisory Committee. The research student is required to keep his or her Committee informed of progress in the research program and to meet with the committee at least twice a year for this purpose as noted above. The work must culminate in a thesis written by the student. The student then must pass a final oral examination. The thesis is subject to approval by the major professor and the student’s advisory committee. The thesis format is subject to the regulations of the graduate school.

Ph.D. Check List

The student is responsible for seeing to it that all these requirements are met on time. If you leave it to someone else, your graduation could be delayed!!

1. Complete M. S. degree when appropriate and gain formal acceptance into the Ph. D. program.
2. Make sure that IUPUI considers you to be a Ph. D. student.
3. File "Plan of Study" no later than semester preceding Preliminary Examination semester.
4. Complete required core Ph. D. course work.
5. Pass Preliminary Examination as soon as feasible, but not later than a year before final defense is scheduled. Note that this is an exam, and as such an official 'Request for Appointment of Examining Committee' with the Purdue Graduate School needs to be filed two weeks before the date of the exam.
6. Complete 90 credit hours total (including M. S. work) and meet the residency requirement.
7. Sign up for zero credit hour Candidate 991 course in expected semester of graduation.
8. Begin the thesis 'format check' process at the beginning of the final semester and meet all subsequent deadlines. An official schedule is published each year. The IUPUI Graduate School Office (274-1577) is the final authority on these matters.
9. Schedule final oral examination and file an official 'Request for Appointment of Examining Committee' with the Purdue Graduate School two weeks before the date of the exam. The 'Examining Committee' is generally the student's Advisory Committee. Note the deadlines (published every Fall and Spring semester) for graduation dates.
10. Schedule, hold, and pass the final examination. The 'Examining Committee' must file an official 'Report of Ph.D. Examining Committee' with the Purdue Graduate School before the end of the semester. This form is not on file! It is only sent in response to a request for an examination.
11. Present a Departmental Seminar on research work.
12. Assure that the advisor signs off on the 'Candidate Audit Report'.
13. File a copy of the thesis with the Department in addition to those required by the Graduate School.

English Requirements

There are English requirements for international students. An applicant's TOEFL, IELTS, or domestic degree, must be within 24 months from the date of Purdue admission. If the score or degree was earned before that time, they will need to retake the TOEFL or IELTS. There are specific scores that need to fulfil the English requirement. In the IELTS exam a score of 6.5 or better (with at least 6.0 in each section) needs to be obtained. In TOEFL a minimum score of 79 (with partial minima of 18 in speaking, 18 in writing, 14 in listening, and 19 in reading) is necessary.

IUPUI's English for Academic Purposes (EAP) exam cannot be used as the proof of English proficiency for Purdue programs (this includes certificates, master's and doctoral degrees).

All students admitted to IUPUI who are not native speakers of English must take the IUPUI ESL Placement Test administered by the ESL program. Based on the results of the test, students needing further language support enroll in IUPUI ESL courses appropriate for their level of English proficiency while taking academic subject area courses. Students must pass the placement test at an appropriate level established by the ESL program in order to serve as a TA.

Physics Department Faculty Research Interests

Ruihua Cheng: Experimental Materials Science and Condensed Matter Physics

Ricardo S. Decca: Experimental Condensed Matter Physics and Materials Science

Andrew D. Gavrin: Experimental Materials Science and Physics Pedagogy

Yogesh Joglekar: Theoretical Condensed Matter Physics

Marvin D. Kemple: Experimental Biological Magnetic Resonance

Tony Lee: Theoretical Non-Equilibrium Physics

Le Luo: Atomic Molecular and the Optics of Physics

Jeff Ou: Quantum Optics

Horia Petrache: Experimental Membrane Biophysics

Steve Presse: Biological Physics and Condensed Matter

Gautam Vemuri: Optical Physics

Stephen R. Wassall: Biophysics of Lipids

Fangqiang Zhu: Theoretical and Computational Biophysics