



Graduate Handbook

Revised October 2015

Introduction

In order to complete the MS or PhD program at ISU you must successfully satisfy two sets of requirements, namely, the Graduate College requirements and the requirements of the Department of Physics and Astronomy. The first set of requirements appears in the *Graduate College Handbook*, which can be found on the ISU website at:

<http://www.grad-college.iastate.edu/deadline/publications.html>

The second set of requirements is presented in this document, which we hope will aid you and your advisor in making the decisions that will affect your graduate studies. Please look this document over carefully. Remember to consult your advisor (or any member of the Graduate Status Committee) if you are uncertain about the nature of the course requirements. It is better to ask now than to discover problems later.

Department Tuition Scholarships and Teaching Assistant Stipends

The Department of Physics and Astronomy offers scholarships covering the portion of tuition not covered by the College of Liberal Arts and Sciences to all incoming students. The continuation of this scholarship beyond the first year is contingent upon both satisfactory academic and teaching performance.

Graduate students who are making satisfactory academic progress are usually appointed as teaching assistants for up to two academic years. After the first semester, the stipend for this appointment will be based on teaching performance and are divided into “high”, “middle” and “low” categories.

Oral English Certification Test

Graduate students for whom English is not their native language will be required to take the University Oral English Certification Test in order to qualify for teaching assignments within the department. Your certification level on this exam determines what type of teaching assignments you may be given. Those of you who do not qualify at Level-1 on the Oral English Certification Test will be required to take English 180 in order to improve your English skills.

Please keep in mind that the department requires that you make progress towards at least Level-2 certification during your first year in the department. You are required to achieve at least Level-3 certification by the end of your first semester at ISU, and at least Level-2 certification by the beginning of the fall semester of your second year. Your tuition scholarship is tied in part to your teaching performance and your Oral English Certification is a part of that performance. Failure to achieve the required level of certification may result in the loss of the tuition scholarship.

Advanced students may also return to teaching after joining a research group. In this case you must have achieved at least a Level-2 certification on the Oral English Certification Test or you will not receive a department contribution towards the tuition scholarship.

Summary of Graduate College Academic Requirements

Here we briefly summarize some of the basic course-credit requirements for graduate students as stated in the *Graduate College Handbook*. (For additional information on transfer credits, time limits, "over-age" courses, residency, English requirements, etc., please see the *Graduate College Handbook*.)

MS Degree

Master of Science or Master of Arts – Thesis: At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from ISU. Students are expected to research and write a thesis that demonstrates independent and creative work. Any transfer of credits from another institution must be recommended by the Program of Study (POS) committee (see the section six of this document). Graduate credit is approved for transfer only if a grade of "B" or better has been earned for a regular graduate-level course taken as a graduate student.

MS Nonthesis: Same requirements as for MS with thesis, except that 699 research credits do not count towards the 30 credit minimum. Two credits of 599 are used instead. Substantial evidence of individual accomplishment (which may vary from a special report, for example, or an annotated bibliography, or a project in research) must be presented in writing to the POS committee.

PhD Degree

Doctor of Philosophy: A minimum of 72 graduate credits must be earned for a Ph.D. At least 36 credits, including all dissertation research credits, must be earned under the supervision of the student's POS committee. A POS committee may recommend transfer of master's degree research credits earned at another institution toward partial fulfillment of the PhD requirements at ISU.

Academic Requirements of the Department of Physics and Astronomy

Physics and Applied Physics Degree Program

MS Degree

M. Sc. in Applied Physics: required core courses are Physics 571, 591, 470 (6 cr.), either 572 or 531 and research component 699 (3 cr.).

Additional six credits are required outside the major field, with three credits being required outside the Department and three credits from a 500- or 600-level introductory course in another area in the Department (see Table 1 at the end of this document).

M. Sc. with Thesis: required core courses are Physics 571, 572, 591, 592 and either 531 or 564. A minimum of 30 credits of acceptable graduate work, not less than 21 being in the Department of Physics and Astronomy. At least 15 of the credits in the Department of Physics and Astronomy must be in courses at the 500 and 600 level. (See Section 4 for further details.) Up to 8 credits of 699 (but not 599) can be applied toward the minimum of 30 credits.

M. Sc. Nonthesis: As above, but the research component is met through a maximum of two credits of 599. No credits of 699 can be counted toward the total of 30 credits.

It is strongly recommended that all MS students take Physics 551.

PhD Degree

All Ph. D. candidates are required to complete following graduate courses: Physics 571, 572, 591, 592, 531 and 564. Each candidate for the doctor of philosophy degree is required to teach one year of elementary physics and/or astronomy. Only teaching in at least one recitation section per semester is counted towards this requirement, labs and grading assignments do not. Please note that your level of Speak-Teach certification will determine what sort of assignments you can be offered (see the previous section on Speak-Teach certification).

To avoid overspecialization, a significant body of pertinent coursework must be taken outside the major field. For the PhD – 9 credits of applicable graduate courses are required (either inside or outside the department) and must include at least one 500- or 600-level introductory course in another area of physics (see Table 1 at the end of this document). Courses in other departments must be listed as “non-major graduate credit” in the ISU course catalog.

It is strongly recommended that all Ph. D. students take Physics 551.

Astronomy and Astrophysics Degree Program

Astro Course Requirements

Two basic courses (Astro 505, 510) will provide a fundamental grounding in general astrophysics (Astro 505), along with basic hands-on experience in observational techniques and methods (Astro 510) that will provide essential insights for researchers in all areas of the field. All students should start with Phys 528 (or a comparable course in math, statistics or computer science, depending on their background and needs) and Physics 571 in their first Fall semester. Astro 510 should be taken at the earliest offering available. Both Astro 505 and 510 are required for M.S. and Ph.D. students.

The remaining core courses (580, 582, 584, and 586) should be taken one per term, through the end of their second year at ISU. Since each of those courses are offered biennially, students who stay at ISU beyond a second year will have an opportunity to take any or all of them. Each requires only Astro 505.

Astrophysics Ph.D. candidates should take all six Astro core courses, if possible, but must take at least three of Astro 580, 582, 584 and 586. Candidates for the M.S. degree are required to take only two core courses beyond Astro 505 and 510.

Core Courses

- Astro 505: Astrophysical Cosmology
- Astro 510: Observational Astrophysics
- Astro 580: Stellar Astrophysics
- Astro 582: High Energy Astrophysics
- Astro 584: Galactic Astrophysics
- Astro 586: Extragalactic Astrophysics

Physics Course Requirements

Physics 571 (E&M), Phys 591 (Quantum Mechanics) and either Phys 531 (Statistical Mechanics) or 564 (Classical Mechanics) are required for a PhD in astrophysics. Masters students are required to take two courses chosen from that list (571, 591, 531, 564) in consultation with their advisor.

Astrophysics graduate students are subject to the same requirements as other students in the department in terms of out-of-area and out-of-department courses (summarized above under the Physics and Applied Physics Degree Program).

The Preliminary Oral Examination.

As part of the PhD degree requirement, a student who has passed the written Qualifying Exam must pass a Preliminary Oral Exam before the final Thesis defense. This is a Graduate College requirement. The preliminary exam must be taken by the end of the third year or within 18 months of passing the Qualifying Exam, whichever comes first. Please note that you must pass the Graduate English Exam before you will be allowed to take the Preliminary Oral Exam.

The purpose of the Preliminary Oral Exam is to demonstrate to the student's advisor and committee that the student is ready to undertake a PhD research project and has a mastery of general physics and to assist the student and his or her advisor in planning and completing the Thesis research project in a timely fashion. A 30-50 minute talk should be prepared by the student, based on a topic decided mutually with the adviser. It is beneficial for the selected topic to be related to the student's future PhD Thesis research field, to minimize the PhD degree completion time. However, original research results are not required for the Preliminary Oral Exam. As examples, the talk might be based on a paper in the literature, or might be related to the student's expertise in using experimental apparatus on which the student's future PhD Thesis research will be carried out (for experimental projects), or the talk might demonstrate analytical or computational competence for theoretical projects. The talk might describe, for example, a future research problem that could be the basis of the PhD Thesis, with the understanding that the final Thesis may deviate from the original plans, based on information gained as the project progresses.

The evaluation of the Preliminary Oral Exam by the committee depends on the understanding demonstrated to the committee by the student of the methodology of carrying out PhD work for a specific problem and not on the amount of research work completed at the time of the Preliminary Oral Exam. Questions on general physics knowledge are a normal part of the Preliminary Oral Exam. In addition, students who plan a dissertation in astrophysics can expect questions in that area. For these reasons this exam should be taken without a significant lapse of time after passing the written Qualifying Examination.

The Program of Study (POS)

The Program of Study is essentially a listing of all courses that you have taken (or plan to take) to fulfill your degree requirements. Once a Program of Study Committee is formed in consultation with your advisor, the Graduate College POS form is filled out and submitted to the Graduate Status Committee for review. The POS is examined to insure that it fulfills all the degree requirements of both the department and the Graduate College and approval is granted for any transfer credits. Once approved by the committee the POS is filed with the Graduate College by the department.

For complete information on the Program of Study please consult the *Graduate College Handbook*. The Program of Study is required before you can take the Preliminary Oral Examination. Common reasons for delay in approval of the POS are listed in Appendix A. Please keep in mind that the Graduate College requires that the POS be submitted and approved

at least one semester before the preliminary exam (or final exam for MS students) can be held.

In addition to the requirements of the Graduate College, the Physics Department requires that the GPA for all courses listed on the POS be a 3.0 or greater. Please note that this is a more strict requirement than the graduate college, which requires an overall 3.0 GPA.

The Graduate Status Committee Graduate Student Review

Early each fall, after the qualifying examination, the GSC will review the academic record of each graduate student in the department for the purpose of determining whether the student is completing appropriate course work at an acceptable rate and is maintaining an acceptable grade average. Guidelines for minimal acceptable coursework progress at ISU are given below:

- a. A student is expected to earn at least six credits per semester with a GPA of at least 3.0 during the first year as a graduate student.
- b. After 2 years, a student is expected to have earned a total of at least 24 credits (17 of which should be in 500 and 600 level physics or astronomy courses) with a GPA of at least 3.0 (Note that this GPA is evaluated over the full 24-plus credits.)
- c. Students beyond the second year of graduate study must maintain a cumulative GPA at or above 3.0.

In each case, the courses Physics 500, 599, 650, 699, Astronomy 599, 650, and 699 are excluded when counting the number of course credits earned and when computing the GPA. Both graduate and undergraduate level courses taken as a Department of Physics and Astronomy graduate student are included in the number of credits earned and in the GPA calculation. Students with transfer credit are considered on an individual basis.

A student whose performance falls below these standards risks loss of financial support and may be declared ineligible for further work toward an advanced degree in the department. Written comments from the student's faculty advisor will be considered before a decision is reached on the student's status. A student may petition the GSC for special consideration in unusual circumstances.

Students are urged to schedule their oral Preliminary Examination as soon as possible after filing their degree program. This examination must be passed within one year of the date that the degree program has been approved by the graduate office. Advanced students who pass the qualifying examination at the end of their first year of graduate study at ISU are expected to form a Program of Study Committee and to file a degree program as soon as possible but no later than the end of the fall semester of their third year.

The research progress of a student will also be reviewed. Comments of both the student and the major professor will be primary input. The GSC's main concern will be to ensure that the student finishes a PhD within the six years allowed by the department. Students seeking a PhD should not expect departmental funding after six years (or three years for MS students.)

Table 1: Outside Area Course Listings by Specialty

Courses - Physics	Astro Physics	Applied Physics	High Energy Physics	Nuclear Physics	Condensed Matter	Particle-Astro	Bio Physics
500 (Intro. Sem.)							
501 (Oral Comm.)							
511, 512 (Condensed Matter)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE
521 (Ultrafast Laser Science)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE
526 (Particle and Nuclear)	OUTSIDE	OUTSIDE			OUTSIDE		OUTSIDE
528 (Math Methods)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
531 (Statistical Mech)							
532 (Biological Physics)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	
534 (Symm. and Group Th.)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
535,536 (SC Dev, crosslist EE)	OUTSIDE		OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE
541 (General Relativity)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
551 (Computational)							
561 (Physics of Biomolecules)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	
564 (Mechanics)							
571, 572 (E & M)							
590 (Special Topics)		E	C	A	B	D	F
591,592 (QM)							
611 (Quantum Solids)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE
624,625 (Adv. Nuclear)	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE	OUTSIDE
637,638 (Adv. High Energy)	OUTSIDE	OUTSIDE		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
646 (Math, Modeling)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
650 (Advanced Seminar)		E	C	A	B	D	F
660 (Special Topics)		E	C	A	B	D	F
681 (Quantum Field Theory I)	OUTSIDE	OUTSIDE				OUTSIDE	OUTSIDE
682 (Quantum Field Theory II)	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE
Courses - Astronomy							
505 (Astrophysics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
510 (Observational)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
580 (Stellar Astrophysics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
582 (High Energy Astrophysics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
584 (Galactic Astronomy)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
586 (Extragalactic Astronomy)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
590 (Special Topics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
650 (Advanced Seminar)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
660 (Advanced Topics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE
675 (Advanced Stellar Astrophysics)		OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE		OUTSIDE

Legend: Courses "OUTSIDE" the area labeled for normal PhD programs. For courses 590, 650, and 660, the letter (A-Nuclear, B-Condensed Matter Physics, C-High Energy, D-Particle Astro., E-Applied, F-Biophysics) indicates which section is "inside area" for the associated major discipline. A blank means a course cannot be used as an "outside the area" credit. For the major areas Applied Physics the student's Program of Study committee has the responsibility of designating additional courses as "inside/outside the area" courses.

Appendix A: Common Reasons for Delays in Program of Study Approval

The Graduate Status Committee reviews POS applications and makes recommendations to the Department Chair. Common reasons for delay of approval of POS applications are listed below. Attention to these points will significantly reduce problems with approval of your POS:

1. Insufficient number of credits outside the department or outside the area, and/or too narrowly specialized POS.
2. Incorrect listing of “Tr” or “Z” categories for courses:

The “Z” listing is for courses that are not acceptable for graduate credit at ISU. (See current *Graduate Catalog* for courses that are acceptable for graduate credit.)

The “Tr” listing is for transfer credits

3. Lack of core courses such as 571-2, 591-2, etc.
4. Poor proof reading - check carefully for typos!
5. Check for minimum total credits required. Specify all 699 credits and years to be taken.
6. Courses taken that will be beyond the 7-year time limit (final oral date) must be addressed by the major professor with a memo indicating the relevancy of the courses to the current POS and how the student will be tested over the material.

Appendix B: Timetable of Events Leading to Graduation with PhD

The following is a summary of the bureaucratic milestones on the road to graduation. For more information, consult the *Graduate College Handbook* or *Thesis Manual*.

1. Appointment of Program of Study (POS) committee within 1 month of passing Qualifying Exam. Keep in mind that the POS committee should include outside the area of specialization.
2. Program of Study completed by end of semester in which POS Committee is formed and submitted to Graduate Status Committee for review.
3. Preliminary oral passed within one year of appointment of POS Committee formation.
4. Submit “diploma slip” during the first week of the semester of graduation notifying the Graduate College of your intention to graduate.
5. First thesis submission to the Graduate College must be made no later than 8 weeks before graduation. (This is no longer required by the Graduate College but is strongly advised.)
6. Submit request for final oral no later than 7 weeks before graduation.
7. The final oral examination must be taken no later than 5 weeks before graduation. (College rule specifies 3 weeks; Physics and Astronomy has decided that 5 weeks is more appropriate to allow time for any revisions required by the POS committee).
8. Final thesis submission 3 weeks before graduation.
9. Graduation (!)

Appendix C: Department of Physics and Astronomy Graduate Minor Requirements

1. A graduate student seeking a **Ph.D. with a minor in physics** is required to have:
 - a) at least 12 credits in physics or astronomy courses acceptable for graduate credit.
 - b) of these 12 at least 6 credits must be from the following list of (core) courses: Phys 480, 481, 571, 572, 591, 592, 531, 564.
2. A graduate student seeking an **M.S. with a minor in physics** is required to have:
 - a) at least 6 credits in physics or astronomy courses acceptable for graduate credit.
 - b) of these 6 at least 3 credits must be from the following list of (core) courses: Phys 480, 481, 571, 572, 591, 592, 531, 564

These requirements apply to all specialty areas in physics. At present, the department does not offer specific minors for the fields of applied physics, condensed matter physics, nuclear physics and high energy physics, though these are listed as separate majors in the graduate catalog.

3. A graduate student seeking a **Ph.D. with a minor in astrophysics** is required to have:
 - a) at least 12 credits in physics or astronomy courses acceptable for graduate credit.
 - b) of these 12 at least 6 credits must be from the following list of (core) courses: Astro 505, 510, 580, 582, 584, 586
4. A graduate student seeking an **M.S. with a minor in astrophysics** is required to have:
 - a) at least 6 credits in physics or astronomy courses acceptable for graduate credit.
 - b) of those 6 at least 3 credits must be from the following list of (core) courses: Astro 505, 510, 580, 582, 584, 586

Students are reminded that the Graduate College requires them to have a Program of Study committee member from the minor area.

Appendix D: Department Physics and Astronomy Graduate co-Major Requirements

1. A graduate student seeking co-major M. Sc. or Ph. D. degree in Physics or Astronomy must fulfill the same requirements as for the respective regular degree with exception of “out of area” requirements:
 - a) Have a co-advising Faculty from Department of Physics and Astronomy
 - b) Complete core courses as outlined Academic requirements
 - c) Pass qualifying and preliminary exams (Ph. D. only)
 - d) Pass thesis defense examination. The thesis defense is a joint exam between the two Departments. Selection of POS committee should provide adequate representation of the faculty members from both departments, including "out of area" member for each department.
 - e) The required “outside department” members of the committee would need to be from a third department.
 - f) The "out of area" course requirement is naturally fulfilled by the courses taken as the other part of the co-major degree.”

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