Graduate Toolkit
Department of Physics & Astronomy
The University of Alabama

as revised 2024/2/2

I Introduction

The Department offers both the Ph.D. degree in physics and the M.S. degree in physics. The M.S. degree includes both a thesis option (Plan I) and a non-thesis option (Plan II). Both the Ph.D. and the M.S. degrees in physics are offered with specialization in astronomy. The requirements for these degrees are outlined in the general and departmental sections of the Graduate Catalog. This "toolkit" document provides supplementary information to assist students and faculty in consistently implementing those policies. Checklists, advising worksheets, and the various forms needed for the completion of a degree, can be found on the "Resources For Current Grad Students" page on departmental web site, physics.ua.edu. Students are advised to make personal copies of completed forms before submitting them. Students are subject to the general rules and regulations of the Graduate School as given in the Graduate Catalog as well as the specific rules and regulations of the Department of Physics and Astronomy.

Each student has an individual responsibility to know and understand the rules and regulations of the Graduate School and of the Department and the requirements for the degree that he or she is pursuing. Students are encouraged to consult with their faculty advisors or the department chairperson if these requirements are not clearly understood. Much valuable and up-to-date information can be found on the Graduate School website, graduate.ua.edu. You should also be familiar with the departmental site, physics.ua.edu. Each graduate student will be assigned an academic advisor when the student initially enrolls in the Department. After a student has chosen a research advisor (as described elsewhere in this manual), then the research advisor will replace the academic advisor as the student's faculty advisor (unless they are the same).

II Academic Policies and Requirements

II.A Scholastic Requirements

II.A.1 Master's vs. Ph.D. programs

Formal entry into our Ph.D. program is gained by passing the Qualifier Exam (see III.B.1 below). The Graduate Advising Committee will assess whether individual international degrees are equivalent to our Master's degree.

II.A.2 Academic Advising

Before registering for classes each semester, students must discuss their academic schedules with an advisor, to help insure that appropriate classes are taken in a timely way (as well as confirm that PH597 or AY597 is enrolled in each semester and, if relevant, insure the

appropriate research course is taken). Students must obtain an advisor's signature on the departmental advising worksheet before registering for classes each semester. Students must also obtain an advisor's signature on the departmental drop/add form before dropping or adding courses. These forms are available on the departmental web site.

II.A.3 Minimum GPA

According to the Graduate Catalog, a student must maintain a cumulative average of not less that "B" (3.0 on a 4.0 scale) in the graduate courses undertaken at The University of Alabama, and at least 75% of these hours must be completed with grades of not less than "B". Courses in which a student has made a grade of "P" or "S" are not considered in evaluations of academic standing. Students who do not meet these requirements (after having earned 12 semester hours of credit) are placed on academic warning. Warning status must be removed by raising the overall grade point average to "B" or better during the next 12 hours of graduate course work. *Students may not hold an assistantship while on academic warning.* Students who are conditionally admitted must maintain a "B" average during their 12 hours. (PH 597, AY 597, PH 598, and PH 698 can be taken only as pass/fail and cannot be used in computing GPA.) Failure to remove either a warning or conditional status within the prescribed time will result in the student being dropped from the graduate program.

II.A.4 Research

Students are encouraged to engage in research as soon as possible and may explore short-term projects with a variety of faculty before solidifying a thesis or dissertation project. When involved in research, students are expected to enroll in one of several possible research courses, depending on their stage in the program. These research courses, along with their constraints, are as follows:

Course	**When to take**	**Grading**
PH 598 – Non-thesis research	(before Qualifier passed)	[P/F]
PH 590 – Research Techniques	(after core courses completed)	[graded]
PH 599 – Thesis research		[P/F]
PH 698 – Non-dissertation research	(after Qualifier passed, before Prelim passed)	[P/F]
PH 699 – Dissertation research	(after Prelim passed; must enroll continuously)	[P/F]

For example, PH 598 is appropriate for a short-term research project undertaken before a student has passed the Qualifying Exam. PH 698 is appropriate for dissertation-related research before a student has passed the Preliminary Exam. These research courses are described further below.

II.A.5 Good Academic Standing

Graduate students are required to maintain good academic standing within the Department. **Students who are not in good academic standing may have their financial support reduced or withdrawn, or may be dismissed from the program.** The Departmental requirements for maintaining good academic standing supplement the Graduate School requirements; together, these requirements

- all students must make satisfactory progress toward a degree, meaning that:
  - M.S. and Ph.D. students must:
    - maintain a GPA of at least 3.0 in all graduate work;
    - meet every semester with one's academic advisor;
    - take a sufficient number of courses (including research courses) each semester to satisfy degree requirements in a timely way;
    - regularly attend classes and colloquia;
    - make timely progress towards completing the research component of their degrees;
  - Ph.D. students must additionally:
    - pass the Qualifying Exam (see III.B.1) within 2 years (+1 month) of arrival and pass at least one (as yet) un-passed section of each exam administered, starting at the beginning of the second semester;
    - pass the Preliminary Exam (see III.B.2) within four years of arrival.
- M.S. students who wish to be considered for financial support must also pass the Qualifying Exam (see III.B.1, IV.A) within 2 years (+1 month) of arrival and pass at least one (as yet) un-passed section of each exam administered.
- all students must perform their TA or RA duties conscientiously;
- international students must also pass the ITAP language exam within 2 semesters of arrival.
- Students who entered during the 2020-1 academic year have 2 additional years and students who entered during the 2021-2 academic year have 1 additional year on the deadlines stated in this section due to COVID-19 related disruptions during 2020-2.

The maintenance of good academic standing with the Department also requires that graduate students conduct themselves responsibly and respectfully towards other members of our academic community. Indeed, the University has a vital interest in the character of its students, and therefore regards behavior at any location (on-campus or off-campus) as a reflection of a student's character and fitness to be a member of the student body. Accordingly, in addition to the relevant academic thresholds, a student's standing with

the Department is also contingent on compliance with the Code of Student Conduct and adherence to the Capstone Creed.

II.B Enrollment Policies For Graduate Teaching/Research Assistants

The following is a summary of the current graduate school policies regarding course loads for all teaching assistants and research assistants. Physics and Astronomy students should usually enroll in 9-10 credit hours per semester, including courses, research hours (if applicable), and seminar (PH/AY 597) when in residence, in order for degree requirements to be completed in a reasonable time.

Graduate assistants must be full-time graduate students during all periods in which they receive financial assistance from the University or associated agencies. The Graduate School imposes the following enrollment limitations based on your full time equivalent (FTE) award:

TA/RA Award	Min-Max Graduate Enrollment
0.25 FTE	9-15 semester hours
0.50 FTE	6-12 semester hours

In addition it should be noted that immigration regulations limit international students to a maximum of 20 hours per week of employment during the academic year, including any combinations of on- and off-campus positions.

A fellowship, as a non-service award, is outside the scope of these policies. Fellows, by the terms of their appointments, are required to undertake full-time graduate study.

Enrollment during the summer is not mandatory for graduate teaching and research assistants.

II.C Policies On Financial Support

II.C.1 Maintaining Good Academic Standing

A graduate student must maintain good academic standing within the Department (as described in II.A.5); consequences of not maintaining good academic standing are described in II.A.5.

II.C.2 Conditional Admissions

When an applicant's entrance exam or GPA score is not up to University minimum requirements, admission is **"conditional."** There are two important consequences of this: 1) if you do not maintain a graduate GPA of 3.0 or better while in conditional status, you will lose your assistantship; 2) if your GPA is below 3.0 at the end of the term in which you complete your 12th credit hour, you will be dismissed from the program. These two policies are applied rigorously by the Graduate School, so you are urged to apply yourself diligently to your coursework your first year if you are admitted conditionally.

II.C.3 Teaching Assistantships

A new graduate student who has been awarded a teaching assistantship can normally expect to have the TA renewed as long as s/he is in good academic standing (see II.A.5), as stipulated by the student's advisor and the department chairperson, and as long as funds are available. There are time limits, however, on the total number of years that a student may hold a TA. A student working toward a M.S. degree will normally be expected to complete the degree requirements within two years, and financial support will not routinely continue beyond that period. In special cases, upon petition and approval of the department chairperson, financial support may be continued for up to three years. A maximum of six years of TA support is allowed for Ph.D. students. This does not mean, however, that students are automatically guaranteed six years of support. Students are encouraged to graduate in a timely manner, and support will not be continued if it is decided that the student is not making adequate progress. Students who are required to pass the International Teaching Assistant Program (ITAP) exam must do so by the end of their second semester in order to receive continued TA support.

II.C.4 Research Assistantships

Students are encouraged to start research as soon as practical, by discussing opportunities for research with faculty in their area of interest. Many students are supported on research assistantships after their first or second year in residence. This enables a student to focus on research, and make speedier progress toward his or her degree. RAs are generally funded by external grants obtained by faculty members. The amount of the RA stipend varies somewhat, but is usually at least as much as a TA stipend. Continuation of a research assistantship is contingent on the student's satisfactory progress and maintenance of good academic standing, as well as on the availability of funds, which may change from year to year. When a student's research assistantship is not renewed, he or she will be considered for a teaching assistantship, using the criteria of length of time in the graduate program, academic standing (including progress toward degree; see II.A.5), and availability of TA funds.

II.C.5 Fellowships

The Graduate School has several fellowship programs for which students may apply. Graduate Council Regular Fellowships are primarily awarded to exceptional incoming students. Graduate Council Research Fellowships are for students doing research that is funded externally, or may lead to external funding. Dissertation Fellowships are for students in the final stages of the research leading to their dissertation. Physics and Astronomy students have been rather successful in receiving these fellowships, especially the latter two, which carry nice stipends and a certain amount of prestige. Students do not apply directly for these fellowships, but must be nominated by the department. Let your advisor know if you are interested. Check the Graduate School website for more information.

II.C.6 Summer Support

For first-year students in good academic standing, summer support is guaranteed by the department during the summer following their first spring semester. **For international students, this support is contingent upon passing the ITAP exam by the end of their second semester.** The support may be in the form of a RA or a TA. In subsequent years, support is not guaranteed, but almost all students are supported on some sort of assistantship or fellowship. Students interested in summer RA support should approach faculty in their area of interest to see if support is available. Students do not need to register for courses during the summer, and are encouraged to spend as much time on research as possible.

II.C.7 Jobs outside the Department

Teaching and research assistants who hold a 0.5 FTE or greater appointment are not allowed to hold additional employment outside the Department, with the exception of tutoring, without special permission from the department chairperson. The Department's policy is that time not taken up by assistantship duties should be devoted to course work, research, and other degree requirements. Since tutoring aids graduate students in learning the fundamentals of their discipline, a maximum of 5 hours of tutoring per week is allowed. **Tutoring students for pay in a course in which you are assigned is not allowed.** International students are strongly advised to review the stipulations of their visa before considering paid tutoring, because it is often not allowed and may incur a severe penalty.

II.D Time Limits

Masters: All requirements for the Master's degree must be completed during the six years (18 fall, spring, and summer semesters) immediately preceding the date on which the degree

is to be awarded.

Ph.D.: All requirements for the doctoral degree must be completed within the seven-year period (21 fall, spring, and summer semesters) following admission to the doctoral program. A single one semester extension may be granted in compelling extenuating circumstances. If the time limit is exceeded, the student will need to reapply to the Ph.D. program and, upon readmission, retake classes that were taken more than 7 years previously.

III Requirements For The Ph.D. Degree

III.A Course Requirements

Course requirements for the Ph.D. in Physics or with Astronomy specialization (totaling 48 semester hours of coursework and 24 semester hours of research) consist of 5 components:

1. Core Courses (18 semester hours)
2. Sub-Area Courses (12 semester hours)
3. Research Techniques and approved electives (9 semester hours)
4. Seminars, Research Techniques, or approved electives (9 semester hours)
5. Dissertation Research – PH 699 (24 semester hours)

Advising Worksheet: A Graduate Student Advising Worksheet must be kept on file with the department office beginning the second semester of enrollment. The worksheet on file should be updated each subsequent semester, to keep current. Worksheets for each degree program and sub-area can be found at https://physics.ua.edu/graduate-program/graduate-advising/. An "Outline of Ph.D. Program (Plan of Study)" form based on this worksheet must be submitted to the Graduate School by the semester in which 30 hours have been earned.

III.A.1 Core courses (18 hours)

The core courses consist of:
Courses marked with * may be substituted by some sub-area courses (see below). The customary schedule for completing these core courses is to take two each semester, starting in the first semester, in the following sequence:

The completion of any of the above courses (or the equivalent, as approved by the graduate director or department chair) with a grade of B (3.0/4.0) or better prior to enrolling as a graduate student in this department may fulfill the requirement for that course (see Sect. V on Transfer Credit).

PH 501	Classical Dynamics
PH 531	Electromagnetic Theory I
PH 532*	Electromagnetic Theory II
PH 541	Quantum Mechanics I
PH 542*	Quantum Mechanics II
PH 571	Statistical Physics

First Fall:	PH 501, PH 531
First Spring:	PH 541, PH 532* and/or PH 571
Second Fall:	PH 542*

III.A.2 Sub-Area Courses (12 hours)

Students must take 4 courses (12 semester hours) in their chosen sub-area. These should be chosen in consultation with and must be approved by the student's research advisor (if chosen) or the graduate advisor responsible for their sub-area. Substitution of courses within the sub-area courses other than those listed here will be made only at the recommendation of the student's research advisor and should represent a similar level substitution which is more applicable to the student's research specialty. The suggested courses for each sub-area are as follows:

Condensed Matter Physics

1. PH 581 – Solid State Physics
2. PH 585 – Magnetism and Magnetic Materials
3. PH 586 – Advanced Magnetism and Magnetic Phenomena
4. PH 681 – Advanced Solid State Physics

– frequently taken additional courses:

PH 591 – Advanced Laboratory

PH 534 – Digital Electronics

High Energy Particle Physics Theory

1. PH 523 – Relativity
2. PH 561 – Nuclear & Elementary Particle Physics
3. PH 641 – Relativistic Quantum Mechanics
4. PH 642 – Quantum Field theory

– frequently taken additional courses:

PH 661 – High Energy Physics

PH 662 – High Energy Physics II

Experimental Particle Physics

1. PH 561 – Nuclear & Elementary Particle Physics
2. PH 641 – Relativistic Quantum Mechanics
3. PH 642 – Quantum Field Theory OR PH 591 – Advanced Lab
4. PH 661 – High Energy Physics

Astrophysics (within Astronomy specialization)

– core substitutions:

AY 640* – Radiative Processes – in lieu of PH 532 (E&M II)

AY 521* – Theoretical Astrophysics – in lieu of PH 542 (QM II)

---

1. AY 533 – Observational Techniques
2. AY 550 – Stars & Stellar Evolution
3. AY 620 – Extragalactic Astrophysics
4. AY 630 – Galaxy & Stellar Dynamics

– frequently taken additional courses:

AY 580 – Cosmology

PH 523 – Relativity

Astroparticle Physics (within Astronomy specialization

– optional core substitutions:

AY 640* – Radiative Processes – in lieu of PH 532 (E&M II)

---

1. AY 521 – Theoretical Astrophysics

2. AY 580 – Cosmology
3. PH 523 – Relativity
4. PH 561 – Nuclear & Elementary Particle Physics

Precision Timing

– core substitutions:

PH 592* – Precision Timing: Quantum Metrology and Applications
– in lieu of PH 542 (QM II)

PH 591* – Advanced Laboratory – Precision Timing
– in lieu of PH 532 (E&M II)

Choose six hours from the following:

1. PH 532 – E&M II
2. PH 551 – Machine Learning
3. PH 534 – Digtl Elect Comp Interfc
4. PH 581 – Solid State Physics
5. AY 533 – Observational Techniques
6. MATH 554 – Math Stas W/Applictn I
7. ECE 579 – Digital Control Systems
8. ECE 555 – Electromechanical Systems
9. ECE 561 – Quantum Well Elec & Devices
10. AEM 667 – Navigation & Target Tracking

Choose six hours from the following:

1. PH 542 – QM II
2. PH 681 – Advanced Solid State Physics
3. PH 585 – Magnetism: Fundamentals and Applications
4. PH 523 – Relativity
5. AY 640 – Radiation Processes in Astrophysics
6. MATH 557 – Stochastic Processes I

7. ECE 508 – Communications
8. ECE 509 – Communications Lab
9. ECE 562 – Semiconductor Optoelectronics
10. AEM 582 – Space Systems

Courses marked with * may be taken in lieu of the indicated core course only by students within the indicated sub-area. Students must submit a plan of study indicating their sub-area before opting out of the relevant core course.

In some sub-areas, courses past the 4 required sub-area courses are those commonly taken instead of Research Techniques courses (see below). Students should consult their advisor as to which of these they should take.

Typically, one sub-area course is taken each semester, along with core courses, so they are completed by the end of a student's 4th semester. Many of these courses are offered only every other year, so students should consult with their advisor for appropriate scheduling.

III.A.3 Research Techniques and Approved Electives (9 hours)

In addition to the core and sub-area courses, an additional 9 semester hours of graded work is required. This will typically consist of Research Techniques (PH 590) taken with the student's chosen research advisor **after core courses are completed**. This 3-hour course can be repeated. The intention is for the student to learn, in an interactive research-oriented setting, research techniques and background even more specific to the sub-field in which they are working than the sub-area courses. It is allowable to instead take additional elective courses pertaining to this goal (with the consent of the student's advisor), as long as a total of 9 semester hours of graded coursework results.

III.A.4 Seminars, Research Techniques, or Approved Electives (9 hours)

For each semester in residence, full-time students are required to enroll for one hour of PH 597 (Physics Seminar) or AY 597 (Astrophysics Seminar), which are graded on a pass/fail basis. Up to 9 semester hours of seminars (PH 597 or AY 597), can be counted toward the Ph.D. degree. Thus, this requirement will typically be satisfied automatically. If otherwise necessary, these hours may be fulfilled by additional coursework, including Non-thesis Research (PH 598), Non-Dissertation Research (PH 698), additional instances of Research Techniques (PH 590), and approved electives. Note that no more than 9 semester hours of pass/fail coursework (AY 597, PH 597, PH 598, PH 698) can be counted toward the Ph.D. degree.

Physics Seminar requirements include attending at least 10 sub-area seminars (e.g., MINT or Theory) and/or departmental colloquia. First-year physics students must attend a minimum of one MINT and one Theory seminar. For students in the second year and beyond, the division among seminars and departmental colloquia will be determined by the student's advisor, in consultation with the student. Students in the 2nd year and beyond must also make one presentation each semester.

Astrophysics Seminar requirements include attending weekly astronomy seminars, departmental colloquia, and making presentations, starting in the first semester.

Other course requirements: of the 18 hours taken under III.A.3 and III.A.4, a maximum of 12 hours may be taken outside the department. These courses, which must be at the graduate level and relevant to their research, should be from the following departments: Mathematics, Computer Science, Chemistry, Biology, Geology, and departments within the College of Engineering.

III.A.5 Dissertation Research (24 hours)

Students are required to earn at least 24 hours of dissertation research (PH 699). However, a student cannot gain credit for Dissertation Research (PH 699) before passing the Preliminary Exam. Note that, once initiated, enrollment in PH 699 must be continuous until the Ph.D. is awarded. (See also III.E below.)

III.B Qualifying and Preliminary Examinations

There are two separate exams that a prospective Ph.D. candidate must pass. The first of these, the Qualifying Exam, is given early in the student's career and covers primarily advanced undergraduate physics; **passing the Qualifying Exam is a requirement for formally entering the Ph.D. program**. The second exam, the Preliminary Exam, is given before the dissertation research is begun and is more closely related to the student's research area; passage of this exam formally admits one to candidacy for the Ph.D.

III.B.1 Qualifying Examination

The Qualifying Exam is given in part each January and August. Students who do not pass by January of their 3rd year are no longer eligible for the Ph.D. (students entering in January have until August of their 3nd year). Passing the Qualifying Exam in a timely way is necessary (but not sufficient) to maintain good academic standing (see II.A.5). Entering students are encouraged to take the exam offered at the beginning of their first semester, but, as noted in II.A.5, there is no minimum performance required to maintain good academic standing until the beginning of the second semester. As an alternative to passing the Qualifying Exam, **entering** students can submit a Physics GRE score of at least 70th percentile.

Students whose overall score on entry meets or exceeds 70th percentile will be considered to have qualified over all parts. Students whose overall Physics GRE score does not meet this threshold will still be considered to have passed an individual part (Classical Mechanics, Electricity & Magnetism, or Quantum Mechanics) through receiving a corresponding sub-score of the 70th percentile or higher prior to entry. Students who entered during the 2020-1 academic year have 2 additional years and students who entered during the 2021-2 academic year have 1 additional year on the deadlines stated in this section due to COVID-19 related disruptions during 2020-2.

The Qualifying Exam is a written test consisting of four parts covering four areas of undergraduate Physics: the January exam covers Electricity & Magnetism (Part I) and Classical Mechanics (Part II); the August exam covers Quantum Mechanics (Part III) and Thermal Physics (Part IV). Each part must be passed separately with a score of at least 70%. Passing an individual part means it does not need to be repeated in subsequent tries (if subsequent tries are necessary).

III.B.2 Preliminary Examination

The Preliminary Exam focuses on the student's area of specialization, and may include areas of graduate-level physics related to the research. The student in consultation with his/her research advisor chooses a committee consisting of four faculty members. The advisor will not be a member of the committee but will be invited to observe the examination. The department chairperson must approve the committee. A form to be used in selecting the committee is provided on the department website. No more than one committee member can be from outside the department. Students without a research advisor will not be allowed to take the exam.

The Preliminary exam should be passed as early as possible once the student has finished all core courses and sub-area courses and has begun actual dissertation research (normally before the end of a student's 7th semester and no later than the end of the student's 8th semester). The exam consists of two parts: a written research plan and an oral examination. The written research plan (normally 2000-3000 words) developed with the research advisor must be submitted to the committee members two weeks before the oral exam. The research plan should include a description of the problem to be addressed, a literature survey, the approach that will be undertaken to tackle the problem, and a discussion of expected results. The oral examination will consist of a forty-minute presentation of the research plan followed by questions from the committee on the research plan and the application of graduate level coursework to the proposed research. The decision to pass or fail will be based on these two criteria: 1) the student's knowledge of graduate-level physics and 2) the feasibility of the proposed research plan. No more than one dissenting vote is allowed for a pass.

The Preliminary Exam chairperson will notify the department chairperson in writing of the committee decision after the student attempts the exam. After the student has passed the exam, the Preliminary Exam Committee will sign the Application for Admission to Candidacy form. Only two attempts of the Preliminary Exam are permitted. Passing the Preliminary Exam within four years of arrival is necessary (but not sufficient) to main-

tain good academic standing (see II.A.5). Consequences of **not** maintaining good academic standing are described in II.A.5.

III.C Master's Degree En Route to the Ph.D.

Once a student has successfully passed the Preliminary Exam, s/he has automatically satisfied the requirements for the Plan II Master's Degree. This is because the Preliminary Exam can be substituted for the comprehensive master's exam. In order to receive the M.S. degree, the student need only submit two forms: an online Application for Degree (through myBama), and the Master's Comprehensive Exam form.

III.D Record Requirements of the Graduate School (for all Doctoral Students)

The Graduate School of the University of Alabama requires all doctoral students at the University to submit a PhD Plan of Study and an Admission to Candidacy for the Doctoral Degree.Ê

III.D.1 PhD Plan of Study

The Graduate School of the University of Alabama requires all doctoral students at the University to submit a PhD Plan of Study detailing the coursework which a student plans to take in order to complete their PhD. The student should prepare this Plan of Study in consultation with a faculty adviser. The Plan of Study must be approved by the Department. The Graduate School requires all doctoral students to submit this Plan of Study no later than the semester in which the student completes 30 credit hours at the University of Alabama (which is typically the third semester). The Plan of Study is considered as the minimum set of courses that the student will take; it is not unusual for a student to take additional courses beyond those listed in the Plan of Study. In the event that the student's completed coursework is different than that originally foreseen, a revised Plan of Study can be submitted. The form for the Plan of Study is available from the department's website.Ê

III.D.2 Admission to Candidacy for the Doctoral Degree

The Graduate School of the University of Alabama requires all doctoral students at the University to submit an Admission to Candidacy for the Doctoral Degree. This should be submitted once the student has passed both the Qualifying and Preliminary Examinations, has completed all coursework for the degree, and has formed a Dissertation Committee.Ê The form for the Admission to Candidacy is available from the Department's website.ÊThe

Admission to Candidacy must be signed by the faculty members who formed the examination committee for the student's Preliminary Examination.

III.E Research and Dissertation

III.E.1 Selecting a research area and a research advisor

The selection of a research area and advisor should be made as soon as possible after the student has passed the Qualifying Examination. A student cannot gain credit for Dissertation Research (PH 699) before s/he passes the Preliminary Exam. The student should first interview several faculty members whose research may be of interest to the student, and the faculty members will describe potential research projects. The selection of a research area and a research advisor will then be made by agreement between the student and the advisor. As soon as the selection is made, both the student and the advisor must notify the department chairperson in writing. If a student and research advisor mutually agree to end their relationship, the student and advisor must both notify the department chairperson in writing of this action. The student must then begin the selection process again. The Department requires that all students doing research toward a degree be supervised by a research advisor approved by the Department. The student must keep his/her advisor fully and regularly informed of the progress of his/her research. Failure to do so could result in the dissertation not being approved.

III.E.2 The dissertation committee

The student, in consultation with his/her advisor and the department chairperson, will form a Dissertation Committee soon after the Preliminary Examination is passed (by the end of the same semester). The committee will consist of five members of the Graduate Faculty, including the research advisor as committee chairperson, three other faculty members from the Department of Physics and Astronomy, and one faculty member of another department. (The external committee member may be from another institution if prior approval is obtained from the Dean of the Graduate School.) The chair must be a full member of the Graduate Faculty. Students doing theoretical (experimental) dissertations are advised to have at least one faculty member on the committee who is an experimentalist (theorist). At least one departmental member of the committee should be from an area outside the student's major research concentration. If the research advisor is not a regular member of the department (either external or adjunct), a regular member of the department must serve as co-chair. An advisor from outside the department would also serve as the external member of the committee. A form to use in selecting the committee is available on the department website. **The student is required to meet with the Dissertation Committee at least once a year for assistance in monitoring and guiding the student's research.** A written summary of each such meeting should be submitted to the graduate director and

department chair.

III.E.3 Final version of the dissertation

A final version of the dissertation will be given to each of the five members of the Dissertation Committee at least two weeks before the oral defense. The student is responsible for all aspects of the production of the dissertation, including the preparation, typing, reproduction, dissemination to the committee members, and all costs involved. Departmental resources cannot be utilized for the production of the dissertation. Please submit a clean, unbound copy of your completed dissertation to the office after your defense, for our permanent records.

III.E.4 Oral examination

A final oral examination must be passed after completion of the dissertation. This examination follows a public presentation by the candidate on the results of his or her research. The examination will be primarily on the candidate's research work as embodied in the dissertation, but it may also encompass the complete program for the degree. The examining committee will be the Dissertation Committee previously described. No more than one dissenting vote is allowed for a pass. The student may take the oral examination only once.

IV Requirements for the M.S. Degree

IV.A Qualifying Exam

M.S. students are not required to pass the Ph.D. Qualifying Exam (see III.B.1) in order to earn the M.S. degree. **However**, to remain in good academic standing, M.S. students must pass the Qualifying Exam within 2 years (+1 month) of arrival and pass at least one (as yet) un-passed section of each exam administered. Consequences of not maintaining good academic standing are described in II.A.5.

IV.B M.S. in Physics (Thesis Option – Plan I)

IV.B.1 Course requirements

A total of 24 semester hours of coursework is required, in addition to 6 semester hours of research. Course requirements for the M.S. (with thesis) consist of 5 components:

1. Core Courses (12 semester hours)
2. Electives (6-9 semester hours)
3. Research Techniques (0-3 semester hours)
4. Seminars (3 semester hours)
5. Thesis Research – PH 599 (6 semester hours)

Advising Worksheet: A Graduate Student Advising Worksheet must be kept on file with the department office beginning the second semester of enrollment. The worksheet on file should be updated each subsequent semester, to keep current. Worksheets for each degree program and sub-area can be found at https://physics.ua.edu/graduate-program/graduate-advising/.

IV.B.1.a Core courses (12 hours)

The four Physics M.S. core courses consist of:

PH 501	Classical Dynamics
PH 531	Electromagnetic Theory I
PH 541	Quantum Mechanics I
PH 571	Statistical Physics

The customary schedule for completing the M.S. core courses is to take two each semester, starting in the first semester, in the following sequence:

First Fall:	PH 501, PH 531
First Spring:	PH 541, PH 571

IV.B.1.b Electives (6-9 hours)

Students must take at least graded 2 electives (6 semester hours). As many as 2 Ph.D. core courses (beyond the M.S. core) may be taken as electives. Electives should be chosen in consultation with and approved by the student's advisor (if chosen) or a member of the Graduate Advising Committee. These electives, which must be at the graduate level, should be from the following departments: Physics, Mathematics, Computer Science, Chemistry, Biology, Geology, and departments within the College of Engineering. A maximum of 6 credit hours from outside the department can count for the M.S. degree.

IV.B.1.c Research Techniques (0-3 hours)

Up to 3 semester hours of Research Techniques (PH 590), taken with the student's chosen research advisor after the core courses are completed, can be counted toward the M.S. degree.

IV.B.1.d Seminars and pass/fail electives (3 hours)

For each semester in residence, full-time students are required to enroll for one hour of PH 597 (Physics Seminar), which are graded on a pass/fail basis. Up to 3 semester hours of seminars (PH 597) can be counted toward the M.S. degree. Thus, this requirement will typically be satisfied automatically. Note that no more than 3 semester hours of pass/fail coursework (PH 597, PH 598) can be counted toward the M.S. degree.

IV.B.1.e Thesis Research (6 hours)

Students are required to earn at least 6 semester hours of thesis research (PH 599), discussed further below.

IV.B.2 Selecting a research area and a research advisor

A student should first interview several faculty members whose research may be of interest to the student, and the faculty members will describe potential research projects. The selection of a research area and a research advisor will then be made by agreement between the student and the advisor. As soon as the selection is made, both the student and the advisor should notify the department chairperson of the decision in writing. The selection should be done before or during the second semester of graduate study. The department chairperson must also be notified in writing of any change of research advisor.

IV.B.3 The thesis committee

After selection of a research advisor and research area, the student, in consultation with his/her advisor and department chairperson, will form a Thesis Committee. The committee will consist of at least three members, including the research advisor as committee chairperson, one other faculty member from the Department of Physics and Astronomy, and one faculty member from another department. (The external committee member may be from another institution if prior approval is obtained from the Graduate Dean.) A form to use in selecting the committee is available on the department web site.

IV.B.4 The final version of the thesis

A final version of the thesis will be given to each of the members of the Thesis Committee at least two weeks before the oral defense. The student is expected to be responsible for all aspects of the production of the thesis, including the preparation, typing, reproduction, dissemination to the committee members, and all costs involved. Departmental resources cannot be utilized for the production of the thesis.

IV.B.5 Oral examination

A final oral examination must be passed after completion of the thesis. The examination will be both a comprehensive examination on the master's degree program as well as an examination of the candidate's research work as embodied in the thesis. The examining committee will be the Thesis Committee previously described. No more than one dissenting vote is allowed for a pass. The student may take the oral examination only once.

IV.C M.S. In Physics (Non-Thesis Option – Plan II)

IV.C.1 Course requirements

A total of 30 semester hours of course work is required. The course requirements are the same as for the M.S. degree with thesis (IV.B) except that, in place of PH 599 (Thesis Research), the student will take 6 additional hours of advisor-approved electives. These 6 hours must be graded Physics courses (not P/F) and cannot include PH 590 – Research Techniques.

IV.C.2 Oral examination

A comprehensive oral examination on the course content of the M.S. (non-thesis) program must be passed during the last semester of study. The committee will consist of at least three members of the department to be chosen by the department chairperson in consultation with the student. No more than one dissenting vote is allowed for a pass. The student may take the oral examination no more than twice. Note: A student en route to a doctoral degree may substitute the Preliminary Exam for this M.S. oral exam.

IV.D M.S. in Physics with Astronomy Specialization (Thesis Option – Plan I)

IV.D.1 Course requirements

A total of 24 semester hours of coursework is required, in addition to 6 semester hours of research. Course requirements for the M.S. in Physics with Astronomy Specialization (with thesis) consist of 5 components:

1. Core Courses (12 semester hours)
2. Electives (6-9 semester hours)
3. Research Techniques (0-3 semester hours)
4. Seminars (3 semester hours)
5. Thesis Research – PH 599 (6 semester hours)

Advising Worksheet: A Graduate Student Advising Worksheet must be kept on file with the department office beginning the second semester of enrollment. The worksheet on file should be updated each subsequent semester, to keep current. Worksheets for each degree program and sub-area can be found at https://physics.ua.edu/graduate-program/graduate-advising/.

IV.D.1.a Core courses (12 hours)

The four M.S. core courses consist of:

PH 501	Classical Dynamics
PH 531	Electromagnetic Theory
PH 541	Quantum Mechanics
	choose one of:
AY 521	Theoretical Astrophysics
AY 533	Observational Techniques

IV.D.1.b Electives (6-9 hours)

Students must take at least 2 electives (6 semester hours). As many as 2 Ph.D. core courses (beyond the M.S. core) may be taken as electives. Electives should be chosen in consultation with and approved by the student's advisor (if chosen) or a member of the

Graduate Advising Committee. These electives, which must be at the graduate level, should be from the following departments: Physics, Mathematics, Computer Science, Chemistry, Biology, Geology, and departments within the College of Engineering. A maximum of 6 credit hours from outside the department can count for the M.S. degree.

IV.D.1.c Research Techniques (0-3 hours)

Up to 3 semester hours of Research Techniques (PH 590), taken with the student's chosen research advisor after the core courses are completed, can be counted toward the M.S. degree.

IV.D.1.d Seminars and pass/fail electives (3 hours)

For each semester in residence, full-time students are required to enroll for one hour of AY 597 (Astronomy Seminar), which are graded on a pass/fail basis. Up to 3 semester hours of seminars (AY 597) can be counted toward the M.S. degree. Thus, this requirement will typically be satisfied automatically. Note that no more than 3 semester hours of pass/fail coursework (AY 597, PH 598) can be counted toward the M.S. degree.

IV.D.1.e Thesis Research (6 hours)

Students are required to earn at least 6 semester hours of thesis research (PH 599).

IV.D.2 Research and thesis

The general rules concerning research and the thesis that apply to the M.S. in Physics (IV.B) also apply to the M.S. in Physics with Astronomy specialization.

IV.E M.S. In Physics With Astronomy Specialization (Non-Thesis Option – Plan II)

IV.E.1 Course requirements

A total of 30 hours of graduate course work is required. The course requirements are the same as for the M.S. degree in Physics with Astronomy Specialization (thesis option; IV.D.1) except that, in place of PH 599 (Thesis Research), the student will take 6 additional hours of advisor-approved electives. These 6 hours must be graded Astronomy courses (not P/F) and cannot include PH 590 Research Techniques.

IV.E.2 Oral examination

The student must pass an oral examination as described under the M.S. in Physics (without thesis) described in IV.C.2 above.

V Transfer Credit

Students are allowed to apply for transfer of graduate credit earned at another institution. In order for a course to be considered for transfer credit, the student must have earned a minimum grade of "B" on the course. In addition, the student must have achieved an overall average of "B" or better on all courses attempted at the institution from which transfer credit is being requested. The Graduate School must have an official transcript of the credit involved. Up to 1/2 of the required course work for a Ph.D. or M.S. degree is allowed to be transferred, with the approval of the department and the dean of the Graduate School. All credit toward the Master's degree must have been earned during the six years immediately preceding the date on which the degree is awarded. All credit toward the Ph.D. degree must have been earned during the six-year period preceding admission to the doctoral program. A form is available on the department website for submission to the Graduate School in applying for transfer credit.

In some cases, the Graduate School will be unable to grant transfer credit based on the information they have, and may suggest the student submit his or her transcripts to World Education Services (www.wes.com). Upon the recommendation of the department's Graduate Advising Committee, the department will cover the $125 fee for the WES services.